PART I

Vol. 4 JUNE, 1921 No. 6

Journal

—OF THE—

American Ceramic Society

A Monthly Journal devoted to the Arts and Sciences Related to the Silicate Industries

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"AMERICA'S LEADING CERAMIC MATERIAL HOUSE."

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Vol. 4 **June, 1921** **No. 6**

EDITORIAL

THE PERMANENT SECRETARYSHIP

I have looked ahead for many years to the time when the American Ceramic Society could afford to have the full time and full energy of a Secretary of proper qualifications. All who were on the Board of Trustees during the first twenty years will remember that this topic was up before the Board almost every year, not with a recommendation for immediate action, but as a goal towards which we should set our faces and toward the fulfillment of which our annual plans and developments should constantly trend. I can not, at this time, without stultifying myself, do otherwise than add my endorsement to the proposition of full-time Secretary of the proper caliber, which is before the Society for discussion.

I do not wish to take any active part in the discussion of the exact mode of accomplishing this long-considered plan. Those arrangements are for those who are now controlling the work of the Society. I understand there are two plans being discussed: one by which this official should take over the present office of the Secretary, expanding the present functions of the Secretary to include the broader duties of correlating the work of the divisions, securing the coöperation of manufacturers, and in raising funds for research and experiment, *vs.* the other, by which the present Secretary's office would remain undisturbed as a sort of

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accounting department, through which funds are collected, membership rosters are maintained, and routine correspondence is handled, and the appointment of an Organizing Secretary to undertake the promotion and scientific development work.

If I have any preference, I lean to the view that there should be but one Secretary's office, and that under him should be concentrated all work which is now being performed and that which we are hoping will be performed by the new full-time officer. My reason for this preference is that I believe that any man big enough to do the promotion work will also be big enough to administer the routine work on the side (especially as it is now pretty well systematized), without making a burden of it. It would conduce towards economy by making only one office force necessary. It would place at the immediate disposal of the Promoting Secretary the basic data as to existing conditions in the Society with which he would have to be constantly familiar. A well-trained bookkeeper or accountant, and a stenographic force of proper size could take care of all routine work of the Society, and enable the Secretary to concentrate his thoughts upon the real creative work.

My experience in a rather wide field of enterprises has brought home to me pretty sharply the fundamental tendency of human beings to build a wall around their job. Our government departments are a fine illustration. It is to be expected, if we run two separate offices, one for the Recording Secretary and one for an Organizing Secretary, that these two jobs would tend to become unnecessarily isolated from each other, and the degree of coöperation between them would probably not be as good as we would wish. This assumption is not intended as a criticism of any existing personnel. It is merely a general comment on a characteristic trait of human nature, and no matter who we secured for the two jobs, it would probably work out much the same in time.

I think we may very well look to the experiences of the older Engineering and Technical Societies in the country as a guide to our own policy. In most of them, if not all, the organization has been built by the skillful and devoted services of some one

officer. Rossiter W. Raymond, for many years the guiding spirit of the American Institution of Mining Engineers, and Edgar Marburg, the Secretary-Treasurer of the American Society for Testing Materials, are good illustrations of what a paid full-time secretary should be. These men found ample time to administer the business affairs of their organizations as a side line, while devoting their best thought and the bulk of their time to the broader problems of promotion and organization.

Of course, in this proposed venture as in all other human affairs, the success of the enterprise will depend upon the man selected. It would be useless to put in a small man into such a job, for a small man will produce small results. Only the services of a first-class man, one who is already earning a big salary and holding down a big job, would be suitable for this place. If the Society will finance the employment of such a person, they will take the surest possible step towards upbuilding both the Society and the whole Ceramic industry. Please notice that I say "*if the Society will finance this venture.*" I do not say *if they can*, for there is no question but what they *can* do it, if they start out to do it. It may call for new methods, and it may make necessary some encroachments upon the invested funds of the Society, but I feel certain that if the Society really wants to put this thing over, they can readily find a way to do it. Being no longer in touch with the Society's finances or income, I do not pretend to advise as to details. I am only arguing on general principles, but I feel very certain that there is nothing impossible about the execution of the plan, and believe that the full development of the American Ceramic Society can not come until the Society does decide to take the plunge and make this big forward step. I believe that the whole status of the American Clay Industries will be at once improved and uplifted by it. Only a big and powerful organization can do for the industries what they need to have done. The American Ceramic Society is the one organization which can do it, and I believe that now is the fateful hour for it to act.

EDWARD ORTON, JR.

THE RELATION OF THE ARTIST TO THE MANUFACTURER[1]

By Conrad Dressler

ABSTRACT

The achievements of the past owed their beauty to the artist. The excellent technique of the present is due to the efforts of the manufacturer and scientist. The latter quality has now almost superseded the former; yet the esthetic needs are eternal and can not be denied. The efforts of solitary artists are unavailing in a modern world of vast undertakings. It is for the modern factory to reintroduce the artistic spirit.

In the beginning there were no manufacturers, only artists. The vestiges of pottery found on the sites of ancient cities show that variety of shape, that charm and interest which we are accustomed to ascribe to the artistic temperament.

Our museums exhibit examples of pottery from all countries and of all periods. Many clays and raw materials were used by a variety of tribes and races. The results were very dissimilar, but each period and country show something which can be called style which differs from other productions, which is self-contained, finished and satisfying. Each such style has a beginning, a growth and a full period of expansion after which it declines in beauty as if exhausted of its vitality.

Nothing that has been done in modern times equals the artistic quality of the Etruscan vases, the Tanagra figures, the Susa frieze of archers, the Persian and Rhodian ware, the Faienza pottery, the Spanish lustre ware, the Blue Nankin china of the 16th Century, or the old slipware of medieval England. All these qualities are due to the artist.

If we have lost these qualities what have we got in replacement?

The modern manufacturing system has given us wonderful things, but it has not given us beauty.

What is beauty?

[1] Received April 7, 1921.

I can not define, and I do not think any one can define what beauty is, but I can tell you what it is not. It is not perfect squareness, absolute flatness, faultless uniformity, pure whiteness, specklessness, or any kind of precision, nor is it dependent on solidity, resistance to blows, frost, and changes of temperature. All these are manufacturers qualities which I am very far from belittling, which, in fact, I think very highly of, which have been achieved by mighty human effort and ingenuity, and which constitute a great advance in the progress of the world's work.

These qualities, however, even when used with the best taste, are from an esthetic standpoint only negative qualities—they are not inspiring and do not stimulate the mind and the imagination. In fact, they leave us cold. It is true, the results of the use of the manufacturers ware need not be vulgar. In the hands of a clever artist they will not offend the eye, but neither will they arouse any enthusiasm, or give any kind of esthetic pleasure.

Thus, if I may say so, the position today is that the arts of pottery (and this applies, I believe, to many other industrial arts) have been pursued exclusively from the point of view of utility. The progress made has been technical. The quality called artistic has gradually become less until it has disappeared. What has taken its place has been soundness and neatness, and often good taste. These purely negative qualities leave many people comfortable and complacent, but they bring no stirring message to the heart or to the mind.

Some people will say, "is it desirable that we should have stirring messages from inanimate things?"

My own feeling is that there are signs that the reintroduction of the artistic creative quality into modern pottery is becoming not merely advisable, but necessary. The people yearn for it and are willing to pay for it. If this is so, the modern world is so constituted that only the manufacturer is now in a position to restore this spirit.

The small outside potter, the individual artist, can no longer hold their own in the great struggle for existence when, in any measure, capital is required to bring a work to perfection. They

may start on some successful experimental work, but when it comes to providing the modern world with what is needed the scale so vastly outstrips their equipment that they have either to develop into a large establishment themselves or to give up the job.

There are so many examples of the hopelessness of these attempts that I will say no more. I have seen William De Morgan's great efforts finally fail—I have had a similar experience myself, and I have had many friends in England and France who have found it impossible to stand up for long against the march of modern factory production. And yet, are we therefore condemned to give up the hope that pottery shall some day be as beautiful and creative as it has been in the past? Shall we never again see messages of emotion and beauty recorded in plastic clay, and are we definitely condemned to either pure utilitarianism or to a cold and soulless imitation of the styles of the past?

I firmly believe that the spirit of our times is pressing towards a solution of this difficult problem. Architects are calling upon the pottery manufacturers for something which shall be typical of the plastic arts, not merely a reproduction of a stone or wooden example out of some museum, or taken from some old building. They want beauty, originality, esthetic emotion.

The manufacturer sees that it is to his advantage to meet these requirements. He calls on artists to help him. In many cases he is prepared to spend large sums to obtain artistic results.

The public again, trained by the sight of so many beautiful objects in the museums of all the large towns, is becoming more and more alive to the quality of beauty.

Thus the elements are being gathered together and it will soon be possible to bring about a change in the methods of work which will once more make the artistic note the dominant one in the production.

I believe that one of the greatest troubles which now exist in factories is due to the lack of interest in the workers. There is a monotony in their task which makes it impossible for them to look for any other reward than money. The training and utilization of their esthetic faculty will do more than anything

else to give zest to their occupation to develop a proper "esprit de corps" and a pride in their workshop community.

That this esthetic faculty exists in a greater or lesser degree in most people is an ascertained fact. That it is an asset worth utilizing is another fact of commercial value. How all this is to be done is a problem which I am not going to offer a solution of, but that it is one which must be solved for the sake of the future of our civilization is an undoubted truism.

To sum up:

The achievements of the past owed their beauty to the artist.

The excellent technique of the present is due to the efforts of the manufacturer and scientist.

The latter quality has now almost entirely superseded the former.

Yet the esthetic needs are eternal and can not be denied.

The efforts of solitary artists are unavailing in a modern world of vast undertakings.

It is for the modern factory to reintroduce the artistic spirit. In so doing it will accomplish two ends. It will bring happiness and contentment as well as enthusiasm and emulation to its workers.

It will give a hungering public new forms of beauty by using in a new way those old plastic materials which have already been so fruitful of wonderful results in the past.

THE SOLUBILITY AND FUSIBILITY OF SOME FELDSPAR FRITS[1]

By H. H. Sortwell

ABSTRACT

Twenty frits were made covering the field 10–50% fused borax, 20–90% feldspar, and 0–30% calcium oxide. (1). The *solubilities* of the entire field were found to be less than 1.5% showing that the variations in composition in this field had less effect on the resulting solubility than the degree of smelting, and that all of the frits were sufficiently insoluble for use in glazes. The inclusion of CaO in the frit had a beneficial effect in decreasing the solubility. (2). The *fusibilities* were found to vary from 660° to 1050°C. Substitution of CaO for feldspar up to 10%, maintaining the borax constant, increased the deformation point, but further substitution in this direction had little effect. Substitution of either CaO or feldspar for borax appeared to raise the deformation temperature about the same in either case. A large part of the field was sufficiently fusible for easy working in the frit kiln.

Introduction

In ceramic literature there is a lack of definite information on the solubility of frits for whiteware glazes.

That frits in commercial use are sometimes poorly chosen in regard to solubility was shown by Blumenthal,[2] who determined the solubility of several frits now in use, the compositions of which were unknown.

There are some qualitative data as to what compositions are insoluble and what soluble, but no studies have been made showing the ranges of the materials ordinarily fritted, in which frits of sufficiently low solubility for judicious use in glazes lie.

As a beginning toward the accumulation of such data, a field of frits composed of feldspar, whiting, and borax was made, and the solubilities and, incidently, the fusibilities determined.

[1] Published by permission of the Director, Bureau of Standards. Received March 10, 1921.

[2] Blumenthal, George, *J. Am. Ceram. Soc.*, **3**, 152–154 (1920).

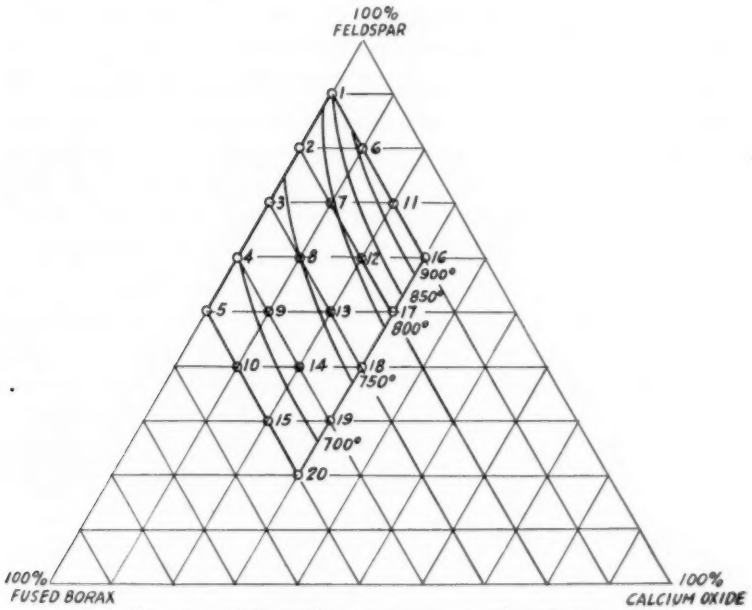

FIG. 1.—Deformation temperatures of used frits.

Experimental

Table 1 shows the melted and raw compositions of the 20 frits made covering the range, 10–50 per cent fused borax, 20–90 per cent feldspar, and 0–30 per cent calcium oxide.

The Maine feldspar used analyzed:

SiO_2	72.85
Fe_2O_3	0.48
Al_2O_3	15.45
CaO	0.31
K_2O	7.89
Na_2O	2.31
Loss on ignition	0.25
	99.54

The frits were weighed out separately, throughly mixed, fused in crucibles and poured into water. As nearly as could be judged, each frit was given just the heat treatment necessary to properly fuse it, in order to avoid as much as possible variations in the re-

sults which would be introduced by the difference in the degree of smelting, as shown by Poste and Rice[1] in their work on enamels.

The solubilities were determined by the method employed by Blumenthal,[2] which consisted of taking five grams of frit sized through 20-mesh and retained on 40-mesh, with 350 cc of distilled water, agitating 24 hours in a rotary shaker, making 17 revolutions per minute, allowing to settle one-half hour, and determining the suspended material and the amount of material dissolved.

TABLE 1
COMPOSITION OF FRITS

	Percentage melted			Raw batch		
No.	Feldspar	CaO	$Na_2B_4O_7$	Feldspar	Whiting	Borax
1	90	..	10	900	...	189.2
2	80	..	20	800	...	378.4
3	70	..	30	700	...	567.6
4	60	..	40	600	...	756.8
5	50	..	50	500	...	946.0
6	80	10	10	800	178.6	189.2
7	70	10	20	700	178.6	378.4
8	60	10	30	600	178.6	567.6
9	50	10	40	500	178.6	756.8
10	40	10	50	400	178.6	946.0
11	70	20	10	700	357.2	189.2
12	60	20	20	600	357.2	378.4
13	50	20	30	500	357.2	567.6
14	40	20	40	400	357.2	756.8
15	30	20	50	300	357.2	946.0
16	60	30	10	600	535.8	189.2
17	50	30	20	500	535.8	378.4
89	40	30	30	400	535.8	567.6
11	30	30	40	300	535.8	756.8
20	20	30	50	200	535.8	946.0

To determine the fusibilities, test cones of standard size were made from the frits passed through 100 mesh, using gum tragacanth for a binder. The fusions were made in a small chromel electric resistance furnace. The temperature measurements were made with a platinum-rhodium thermocouple and a potentiometer indicator. The cold junction of the thermo-

[1] Poste and Rice, *J. Am. Ceram. Soc.*, **1**, 221–233 (1918).

[2] *Loc. cit.*

couple was maintained at zero by means of an iced thermos bottle. The temperature was raised at the rate of 10° C per minute.

Results

Solubility Determinations.—The results of the solubility determinations are shown in table 2. The entire field was sufficiently insoluble for use as frits in glazes. The degree of smelting has greater effect on the solubility than the variations in composition covered in this work. The frits having the greatest solubilities, a little over one per cent, are those consisting of borax and feldspar alone. From this it would appear that a little whiting has a beneficient effect in reducing the solubility.

Fusibility Determinations.—Difficulty was experienced in determining the fusibilities by cones due to the tendency of the borax to segregate at the bottom of the cone, leaving a skeleton of the harder materials. This would occur in successive fusions of the same frit in varying degree. This difficulty has been experienced before in this laboratory in studying the fusibility of enamels for metals. Difference in the degree of melting would also affect the results.

Therefore, the results obtained are only approximate, being the average of several cones of each frit which appeared to fuse with the least segregation. They serve satisfactorily as a basis for comparison and are fairly consistent.

Examination of figure 1, which is a graphical representation of the field showing the isotherms as approximately indicated, shows that replacement of either feldspar or calcium oxide by fused borax lowers the deformation temperature about the same amount in each case.

Substitution of calcium oxide for feldspar maintaining the borax constant increases the deformation temperature up to 10 per cent calcium oxide. Further substitition in this direction has but slight effect in increasing the temperature of deformation.

The deformation temperatures of three representative frits now in use being made in frit-kilns fired by both coal and gas were determined as a criterion of the proper fusibility for frit-kiln frits. These were found to be 717°, 690° and 773° C, respectively.

Judging by these figures and the behavior of the frits in the crucibles, it was estimated that approximately 800° C was about the maximum deformation temperature of the melted frit for easy working of a frit in the ordinary hearth frit kiln.

Consulting figure 1, it is seen that the number of mixtures in this field suitable for frits is large.

TABLE 2

RESULTS

Solubilities and Fusibilities

No.	Deformation temperature °C	Suspended material per Cent	Soluble matter per Cent
1	865	0.21	0.25
2	773	.17	.67
3	720	.09	1.05
4	700	.04	1.08
5	660	.19	1.51
6	943	.16	.24
7	805	.18	.47
8	765	.07	.23
9	715	.07	.40
10	685	.14	.76
11	875	.15	.62
12	810	.10	.21
13	765	.07	.63
14	715	.05	.68
15	692	.09	.98
16	1056	.10	.23
17	810	.16	.38
18	765	.14	.58
19	715	.08	.42
20	702	.02	.63

NOTE ON COBALT STAIN IN WHITE WARE BODIES

By Arthur S. Watts[1]

ABSTRACT

Faulty methods of adding cobalt.—Cobalt oxide or directly added cobalt sulphate frequently causes a blue-gray cast when the body is hard fired.

Correct preparations of stain from cobalt sulphate.—To 750 ounces of pure water add 15 ounces pure cobalt sulphate ($CoSO_4 + 7H_2O$) and stir until dissolved. Then add 7.5 ounces of carbonate of soda (Na_2CO_3) and stir thoroughly.

Adding stain to body.—Ball clay must be thoroughly blunged with body before adding stain. If used in a casting slip, add the stain as a part of the casting solution.

Proportions stain to body.—For a body containing 10 per cent ball clay add 75 ounces stain solution to each 1500 pounds body, *i. e.*, $^1/_2$ ounce stain for each 10 pounds body. For bodies with higher ball clay content increase the stain addition in the same ratio up to 15% ball clay.

Stain in glazes.—Add 10 ounces stain to each 100 pounds dry glaze batch when same is thoroughly wet in mill. For glaze high in lead, the amount of of stain required is increased.

On numerous occasions I have observed that the cobalt stain, used to neutralize the normal yellow tint of white ware bodies, is still made from cobalt oxide and in every case of this kind the amount of stain required to overcome the yellow cast is so great that, if the body is overfired ever so lightly, the result is a distinct blue gray cast. On numerous other occasions I have found white-ware manufacturers using cobalt sulphate dissolved in water and without any salt added to precipitate the cobalt in an insoluble form. The amount of cobalt added in this form is also frequently in excess of that necessary to neutralize the yellow cast of the body. I find that there is a common impression that to convert the soluble cobalt into a form which is insoluble or only slightly soluble in water will cause specks to appear in the ware. For these reasons I desire to offer a procedure for adding cobalt to a white-ware body which I have employed with uniform success for several years.

[1] Received March 10, 1921.

1. Preparation of the Cobalt Sulphate Solution.—To 750 ounces of pure water add 15 ounces of pure cobalt sulphate ($CoSO_4 + 7H_2O$) and stir until all the cobalt is dissolved. Then add 7.5 ounces of carbonate of soda (Na_2CO_3) and stir thoroughly for several minutes. The product will be a milky pink liquid which will settle with difficulty. Provide ten one-gallon fruit jars with covers and in each place 75 ounces of the stain, stirring the batch thoroughly to prevent settling during the process of dividing.

2. Adding the Cobalt Stain.—As soon as the ball clay has thoroughly blunged up in the batch of body, you may add the stain and no sooner. If desired, the stain need not be added until about five minutes before the body is drawn off into the cistern. This cobalt stain can be poured into the blunger without fear of causing dark specks.

3. Proportioning of Stain to Body.—The above cobalt solution is designed to be used in the proportion of 75 ounces of stain to 1500 pounds of a body containing ten per cent ball clay, or one-half ounce of stain for each 10 pounds of body. If the ball clay content is increased, I find the amount of stain should be increased in the same ratio but if the ball clay content exceeds fifteen per cent of the body, it is impossible to produce a pure white product by increasing the cobalt stain.

If the body is to be used for casting and a mixture of carbonate of soda and silicate of soda is added, I find it advisable to introduce the cobalt sulphate directly into the casting solution before it is added to the body. The silicate of soda will cause the precipitated cobalt solution to change from a pink to a dark purple, but this does not apparently change its properties in the body.

4. Stain in Glazes.—I have found this stain very satisfactory for neutralizing the yellow tint of white-ware glazes. To every hundred pounds of glaze being ground add 10 ounces of the stain. This should be added after the glaze has been put into the mill and the water added. If the glaze is very high in lead, the required amount of stain will be greater, but for the average white-ware fritted glaze the above proportions will be found very satisfactory.

COLUMBUS, OHIO

THE VALUE OF AGEING THE TERRA COTTA BODY[1]

By R. L. Clare and R. N. Long

ABSTRACT

It is shown that the terra cotta body when aged for a period of twelve days improves in plasticity, workability and strength. If the body is aged and subsequently repugged, still greater improvement is noted. This process is recommended as developing to the fullest extent the latent qualities of the body. The theory of this action seems to be a softening of the clay grains which with the retempering process results in a finer subdivision of the particles and a more intimate combination of the clay and grog.

Purpose of the Investigation

In an effort to produce the best possible finished product, the relative value of ageing or storing the terra cotta body mixture, as against using the freshly tempered mixture, is a question which should be carefully studied. Many of the ceramic industries, such as the white ware, porcelain insulator, chemical stoneware and glass pot plants, have adopted this method in conjunction with their clay preparation as vitally necessary to the production of good material. Various other of the industries, such as roofing tile, refractory, sanitary ware and terra cotta companies, have found this method to be of great advantage to them and, while not universally adopted, it is found in some of the plants.

It is noted that those industries which have adopted this method to the greatest extent are those making the most difficult wares, which, of course, require the best possible body mixtures that can be produced within economic limits. The terra cotta manufacturers are probably required to make a greater variety of difficult shapes and sizes than any other ceramic industry, yet it is one of the industries that has not universally adopted this method of body preparation.

This investigation was conceived, therefore, to develop some accurate data on the effect on the body mixture caused by the ageing of the body and to show by these facts whether there

[1] Received April 7, 1921.

were any decided advantages to be gained by this extra operation and the extra expense involved. Also, in some of the plants the ageing process is accompanied by a subsequent tempering to get better uniformity, which is unquestionably good practice. We, therefore, extended our investigation to cover the aged and retempered body as well as the aged body without retempering.

The first point to be determined was the proper length of the ageing period. Preliminary tests were made of the working qualities of clay aged one, two and three weeks, the latter being about the practical limit for terra cotta plants. From these observations, it was found that after one week there was a marked change for the better in the clay; after two weeks, there was a slight further improvement, but after three weeks no further change was noted. We, therefore, selected twelve days as the length of the ageing period for these experiments.

We also found that if proper care is taken of the clay and it is not too soft when stored, retempering is not necessary unless still greater strength and plasticity is desired.

Experimental

All of the test pieces were made up from one batch of body mixture. A part of this was made into samples directly after it had been pugged, and marked "A," representing the fresh mixture such as is used in many plants. The remainder of the batch was stored away in the ageing cellar for twelve days when another set of test pieces was made and marked "B," representing what we found to be a well aged clay. The balance of the clay was then repugged, allowed to stand over night, and pressed into test pieces marked "C." This treatment we thought should develop the highest plasticity and greatest strength.

All of the pressing was done by one of our best men and the test bars were so designed as to reduce to a minimum any variation due to the human element. Observations were made during the pressing of each set of pieces so as to determine the plasticity, workability and finishing qualities of the various lots of clay. All the pieces were dried carefully and those to be used for burning were fired to cone 6 in a commercial terra cotta kiln.

Table 1 gives the results from the test pieces and the observations made.

TABLE 1

Test	Body A Fresh mixture	Body B Aged 12 days	Body C Aged 12 days and repugged
Water of plasticity (dry basis)	29.4%	26.1%	23.7%
Linear drying shrinkage (wet basis)	5.76%	5.41%	4.82%
Drying warpage	0.187″	0.094″	0.120″
Drying cracks	None	None	None
Transverse strength (dry)	121.3 lbs. per sq. in	128.5 lbs. per sq. in.	160.1 lbs. per sq. in.
Plasticity and workability	Worked fairly well. Somewhat short. Some cracking while in the mold. Finished piece looked ragged.	Worked better, more plastic, no cracking in molds. Piece finished up much better.	Worked very well. Very plastic. No cracking in molds. Piece finished up better than preceding sample.
Burning shrinkage	2.56%	2.46″	2.53%
Burning warpage	0.143″	0.187″	0.184″
Absorption	17.68%	17.57%	16.58%

The water of plasticity shows a progressive drop, even though some little water was added to body "C" when repugged. This can only be explained as due to evaporation. The linear dry shrinkage checks the results obtained above.

For the purpose of studying the effect of ageing on the tendency of the body to warp in drying, ten test pieces 2″ × 4″ × 16″ were pressed solid in plaster molds and as soon as they were stiff enough to support their own weight without deforming, they were set up on end and allowed to dry at room temperature, protected from air currents. The amount of warpage was then measured by placing a straight-edge across the concave face and the deflection from the straight-edge measured in hundredths of an inch. The figures in the table are the average of ten tests. This shows body "B" to be decidedly straighter after drying

than "A," and body "C" shows an improvement over "A" in this respect, but not as much as "B." The results of this test were very consistent.

The transverse strengths of the dry bodies were determined by breaking ten bars, approximately $1'' \times 1'' \times 8''$ on a $6''$ span and the modulus of rupture computed according to the formula:

$$M = \frac{3PL}{2bd^2}$$

(where P is the load in pounds and L the span in inches). We had hoped that this test would be a fairly accurate measure of the increased plasticity and strength developed by the ageing and repugging operations. The difference between 121.3 lbs. per sq. in. and 128.5 lbs. per sq. in., however, does not adequately show the marked difference between bodies "A" and "B." The increase in strength of body "C" to 160.1 lbs. per sq. in. is remarkable, as it shows the undeveloped possibilities in the average body. The character of the fractures in each of these bodies is interesting. All of the breaks of the body "A" bars are very ragged and seldom under the knife edge. Those for body "B" were nearly all directly under the knife edge and not quite so ragged as "A." Those for body "C" were all directly under the knife edge and showed a comparatively smooth break, indicating a very fine grained clay.

The plasticity and workability show a progressive improvement in the bodies "A," "B" and "C." This was determined from observations made from full-sized terra cotta pieces pressed in the shop from each of the bodies. These results, while not measurable, were very marked and check with the preceding data.

The burning shrinkage results indicate that the ageing had no particular influence on the vitrification behavior.

The warpage during firing was measured by the deflection of a bar $2'' \times 2'' \times 17''$ suspended on clay triangles $12''$ apart and set in the kiln with a $1^1/_2$ lb. weight in the center of each bar. The weight was used to magnify any slight difference which might occur. These results show a very slight increase in warpage for bodies "B" and "C."

The absorption test was made after a twenty-four hour soaking period and two hours boiling. Bodies "A" and "B" are practically the same with "C," 1 per cent lower. This we attribute to the finer subdivision and closer combination of the particles after ageing and repugging.

Theory of the Ageing Process

From the data above, this ageing action seems to be chiefly a slaking or softening process, together with a more uniform distribution of the moisture between the clay and grog grains. We know that ordinary pugging of the mixture does not entirely break up all of the clay particles nor does it thoroughly saturate the larger grog grains. The ageing period, however, allows time for the moisture to soak into these clay particles and to saturate the grog grains so that the resultant mixture is a more uniform and workable mass, but with little or no change in the subdivision of the clay. The retempering process then breaks up these softened particles and produces a finer subdivision of the clay and a more intimate combination of the clay with the grog. A stronger and more plastic mixture is the result. This theory is borne out by the data which indicate a very slight increase in dry strength for the aged body and a very considerable increase when this body is aged and then repugged.

There may be some benefit from bacterial growth or "rotting" of the clay as claimed by some investigators,[1] but this was not evident in this work after a twelve day period. If ageing were mainly dependent upon the bacterial action, then the increase in dry strength should be as apparent in the aged body as in the aged and retempered clay.

Conclusions

Ageing of a terra cotta body for twelve days without subsequent retempering materially increases the plasticity and workability of the clay, slightly increases the dry strength and reduces the tendency to warp in drying. This produces a mixture easier to press and finish, straighter and somewhat stronger in the dry state than the un-aged clay. All of these qualities tend to reduce losses and to insure a better finished product.

Retempering of the body mixture, afer ageing, produces a slight increase in plasticity and workability over the aged body, increases the tendency to warp in drying slightly, and produces a very marked increase in dry strength.

This last quality tends to materially reduce the losses from chipped and broken pieces and allows of greater freedom in handling the dry material. A body such as this would be much safer to use in the manufacture of large pieces than clay that has been aged without retempering.

This process is to be recommended to the terra cotta industry as developing to the fullest extent the latent qualities of the clay mixture used.

REFERENCES

[1] Ogle, *Trans. Amer. Ceram. Soc.*, **3,** 171 (1901); Stover, *Ibid.*, **4,** 183 (1902) and **5,** 358 (1903); Spurrier, *J. Am. Ceram. Soc.*, **4,** 113 (1921).

NOTE ON SAGGER CLAY PREPARATION[1]

By F. K. Pence

ABSTRACT

Better mixture of ingredients.—Saggers can be improved in quality by installing a mixing machine immediately following the dry pan. The *soaking pit* may then be eliminated and the clay and water fed directly to the pug mill. This process permits of *large tonnage* and is of course also applicable to other bodies.

In contributions on the subject of sagger making, much emphasis has rightfully been placed upon the composition of the sagger body, the nature and quality of the clays used, the percentage of grog, the size of grinding, etc.

Another factor having a vital influence upon the resultant quality of the sagger is the method by which the various ingredients of the sagger body are brought to the state of plastic mixture ready to be moulded into the sagger.

We are all familiar with the old dry pan, soaking pit, pug mill process by which the body was brought to a condition of apparent homogeneity. Some have used the wetpan as a pugging device in order to develop plasticity and secure more intimate mixture of ingredients. This is a disadvantage from the standpoint of capacity as the wetpan is a retarding element.

Extensive observations led the writer to believe that improvement in quality could be obtained by insisting on greater homogeneity in the body mixture. In the old soaking pit method, a semblance of mixing was obtained by the manner of grinding the clays and filling the pit, and the pugging was supposed to complete the process of securing uniformity. However, by altering the procedure as described briefly below, the following, a distinct improvement in quality, was noted.

An experiment was made in which the proper amounts of ground clay and grog were intimately mixed in an ordinary cement mixer before any water was added. The mixture was

[1] Received March 10, 1921.

then wet down and pugged through in the regular way. The results obtained were so satisfactory that the process of dry mixing as a means of securing intimate uniformity became a matter of important attention. Further investigations confirmed the results of this preliminary experiment to the end that the writer strongly recommends the installation of a device of sufficient capacity immediately following the drypan, whereby intimate dry mixing of all ingredients may be secured. The remainder of the process may now be as before, but the status of the mixture makes possible a greater efficiency at this point.

The soaking pit may now be eliminated and the clay and water fed into a double pug mill and auger machine to produce a bar of plastic clay as in a stiff-mud brick installation. This clay can be cut into proper lengths, and made at once into saggers with good results. However, if this clay is stored for a period of thirty-six to forty-eight hours or longer, covering with damp cloths to prevent evaporation, a further marked development of working properties will be secured.

The process as outlined in the foregoing admits of large tonnage capacity and applies, of course, to the preparation of plastic clay mixtures other than sagger bodies.

ZANESVILLE, OHIO

APPLICATION OF ELECTRIC HEAT TO VITREOUS ENAMELING[1]

LAWRENCE E. BARRINGER

ABSTRACT

A two-compartment open-chamber furnace with separating door operated from the outside is described. The source of heat is an electric current passed through a nichrome resistor ribbon wound over refractory supports arranged along the sides of the furnace. The front or preheating compartment is operated at 300°C and the back or finishing compartment at 900°C, with automatic control. The advantages, compared with oil heating, are: rejections reduced from 25 per cent to zero; 50 per cent increase in output for same floor space; 47.4 per cent lower fuel cost; improved quality and uniformity; lower maintenance cost and greater ease of operation.

For some years the writer has believed that electric heat would prove ideal for the heating of furnaces used in enameling work where the conditions are quite suitable for the direct application of this method of heating.

Electric heat has often been discussed with reference to various ceramic operations, but in some branches of the art there are difficulties which would prove insurmountable at this time and which would necessitate radical and expensive changes in kiln or furnace design and plant arrangement. The situation is rather complex, for instance, when one considers the possibility of applying heat to pottery kilns. The space to be heated is large and the transmission of heat from the electric sources would be difficult. The heat conductivity of pottery ware and saggers is low and therefore the even distribution of heat either by convection or by conduction would be, with the same types of furnace, much more difficult with heat from electric energy than from coal, oil or gas.

Then, too, the temperatures involved in pottery operations are comparatively high and increase the difficulties of uniform firing, particularly in the manufacture of porcelain, as electrical porcelain, spark plugs, etc.

[1] Received March 7, 1921.

In enameling work, however, the conditions are such as to make possible not only the successful application of electric heat, without serious disturbance of furnace equipment or plant arrangement, but to offer also distinct advantages in the system of electric heating. The muffle furnaces employed are of comparatively small volume, the temperatures are relatively low and well within the range of metallic ribbon resistor construction and the conductivity of the ware is high as compared to green clay wares and saggers.

An electrically heated enameling furnace has been described by Mehling and Carpenter,[1] but the writer wishes to bring to the attention of the Society a further step in the application of electric heat to vitreous enameling work involving the treatment of enameled resistors in a furnace of two compartments with two heats and other special features.

The enameled resistors in question consist of special refractory tubes, or cylinders, made from a fire clay or refractory oxide mixture and fired in porcelain kilns. Upon these spools wire is wound to give the required resistance for units of each class and then enamel is applied over this wire and fused to the usual smooth, glassy, impervious coating. This coating completely embeds the resistance conductor and protects it from moisture, oxidation or mechanical disarragement, thus providing a most durable construction. The enamel employed in this work is of the same type used in ordinary metal enameling and the furnace temperatures lie within the same range.

When this work was started some years ago by the General Electric Co., the work of enameling the resistors was done in the metal enameling shop. After a year or two, however, it was found that the results were not altogether satisfactory, due to a rather high loss because of cracked tubes or spools. This cracking of the resistor spools was caused by sudden heating and cooling and the handling of this class of ware was more difficult than with enameled metal, which will withstand rapid temperature change without physical injury. To cool the enameled resistors slowly was found easy of accomplishment by transferring the

[1] *J. Am. Ceram. Soc.*, **4**, 271 (1921).

racks from the enameling furnaces to closed sheet iron cooling chambers constructed very much like the warming closet in a butler's pantry but the gradual heating required could not be secured with the oil-fired enameling furnaces in use.

An electrically heated furnace was then designed and built by the General Electric Co.'s electric furnace engineers and has been a pronounced success from the outset, not only in reducing rejections and giving a very much improved quality of ware,

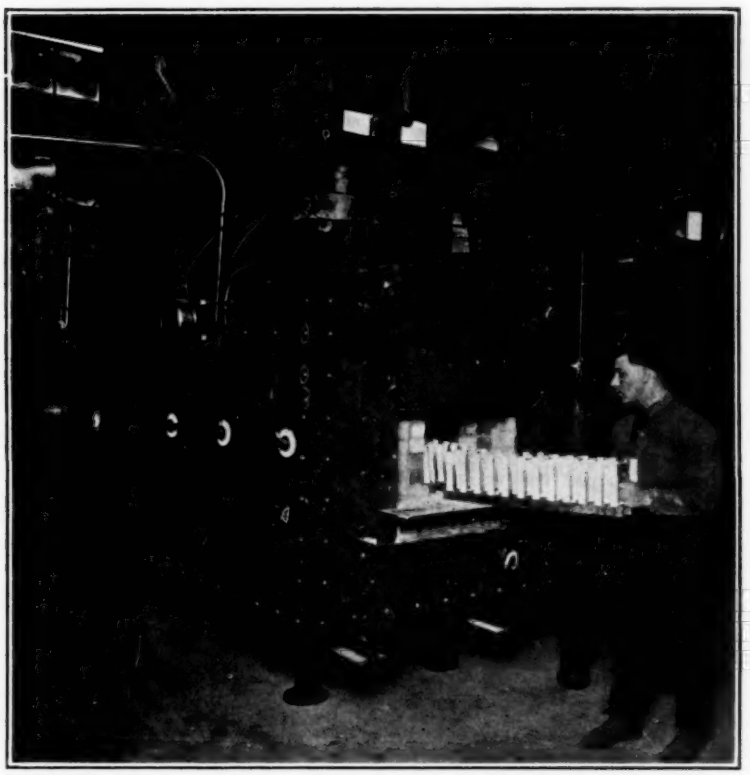

FIG. 1.—Electric vitreous enameling furnace, charging preheating chamber. Preheating chamber 4′ long, 18″ wide, 24″ high inside, 9 kw-300°C operation. High temperature chamber 4′ long, 18″ wide inside, 24″ high, 24 kw-900°C operation.

but also in the matter of cost, having proven a substantial economy over the oil-fired furnace.

The furnace is shown in figure 1. It is substantially built of boiler iron and fire brick. The heating chamber is an open tunnel without muffle and is divided into two compartments by a fire clay door or damper which moves vertically so that it can be raised or lowered as a charge of ware passes from one compartment to the other. Each compartment is 4 ft. long by 18 in. wide by 24 in. high. The ware is placed on sheet steel racks which pass through the furnace on guide rails. Counter weights facilitate moving the dividing door and long handles are arranged so that it can be operated from either end of the furnace.

This feature of graduated or compartment heating is one which would be difficult of accomplishment with other sources of heat, but is very easily secured by electric heat through simply providing the proper resistance and supplying the proper current.

The front compartment of the furnace is used for pre-heating the enamel-coated devices at a temperature of 300° C. This is necessary, as above noted, because if the resistors are subjected to too great an initial heat, many crack. The connected load on this chamber is 9 kw. and the time required to complete the pre-heating of a charge of ware is about 6 minutes.

When the pre-heating is accomplished, the charge is moved into the second compartment, through the centre door, by raising the partition from the outside. In this second compartment the ware is subjected to a temperature of 900° C. for about six minutes, emerging in a finished state. The load on the 900° C side is 24 kw.

The heating units in the furnace are of nichrome ribbon wound over refractory supports composed of highly heat-resistant material and arranged along the sides of the furnace in such a way as to give very even heat distribution.

The control is automatic, the Leeds & Northrup automatic temperature regulator being employed. A view of the control board is shown in figure 2.

There is no difficulty in maintaining a uniform temperature

for indefinite periods ensuring uniformity of quality and regularity of output.

Besides the work of firing enameled resistors with fire-clay bases, for which the furnace was originally constructed, the

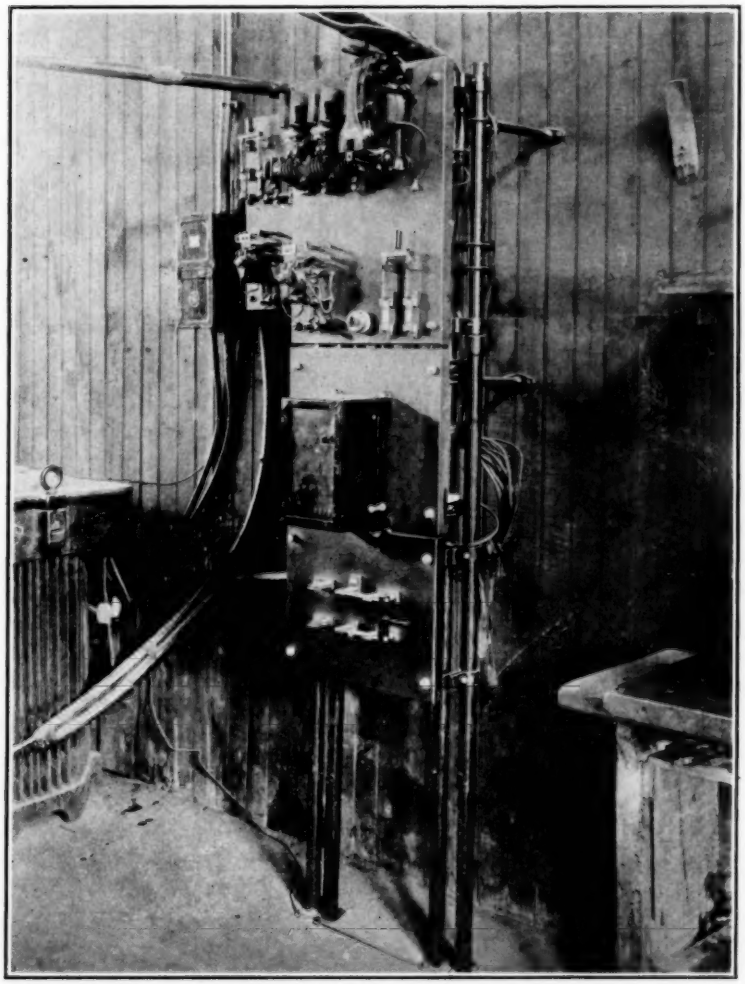

FIG. 2.—Control board for electrically heated enameling furnace.

firing of enameled metal parts has also been carried out with much success and an unexpected advantage was secured in the enameling of steel push buttons. A red enamel is applied to the ends of these buttons to serve as an indicating color to operators. In firing them in the standard oil furnace the edges were

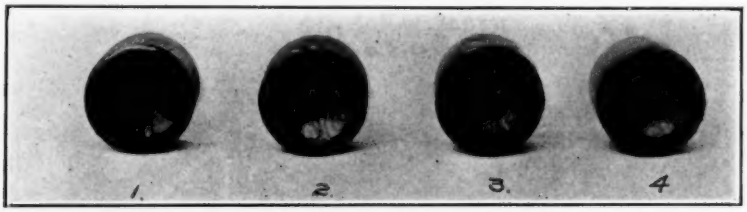

FIG. 3.—Enameled push buttons, numbers 1 and 2 fired in electric furnace; numbers 3 and 4 fired in oil furnace.

never altogether satisfactorily covered and the buttons were frequently found with the enamel shrunken back from the edges or chipped. In the electrically heated furnace the result has been smooth, well-covered edges free from defects as shown in figure 3. The reason for this is left to the reader's determination, but must certainly lie within the conditions of a graduated and even temperature and freedom of the electric furnaces from fuel gases, or other deleterious by-products present in coal or oil-fired furnaces.

As to cost of operation, the following tabulations show "cost runs" made with the furnace handling the products above mentioned.

TABLE 1

Hours run, 4.
KWH consumed, 97.3.
Fired 11 loads of push buttons, 48 pieces per load or 528 pieces.
Weight of push buttons, 52 lbs.
Weight of 11 racks, 121 lbs.
KWH per lb. of load, 0.562.
KWH per lb. of push buttons, 1.87.
Cost per lb. of push buttons, $0.02338.
Cost per push button, $0.0023.

TABLE 2

Hours run, 1.33.
KWH consumed, 43.8.
Fired 9 loads of 35, $6\frac{1}{2}$" resistance tubes or 315 tubes.
Weight of 35 tubes, 9 lbs.
Weight of rack, 13.5 lbs.
Weight of 315 tubes, 81 lbs.
Weight of 9 racks, 121.5 lbs.
Total weight, 202.5 lbs.
KWH per lb. of tubes, 0.541.
KWH per lb. of tubes and racks, 0.266.
Cost per lb. of tubes and racks, $0.00028.
Cost per lb. of tube, $0.00676.
Cost per tube, $0.0017.

With the oil furnace that this electric furnace has replaced, the oil consumption was an average of 6 gallons per hour. At 13 cts., the price of fuel oil at the time, the cost per hour was $0.78. The cost of operating the electric furnace, taking the figures of table 2, which have been found maximum rather than average, the cost of the electric furnace for current is $0.41 per hour. There is thus a direct saving of $0.37 per hour or 47.4%.

In this installation, therefore, the following advantages have been secured by substituting electric heating for oil heating.

1. Reduction of rejections from 25% to practically zero.
2. Increase of 50% in output without increase of floor space.
3. Fuel saving of 47.4%.
4. Improved quality.
5. Higher degree of uniformity.
6. Fewer furnace repairs and lower cost for maintenance.
7. Greater ease of operation.
8. Furnace heated up more quickly by elimination of muffle.

The writer believes that most, if not all, of these advantages are available to any factory producing enameled ware or specialties and that the electrically heated furnace will be the furnace of the future for this branch of the ceramic industry.

RESEARCH LABORATORY
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THE ABSORPTION OF SODIUM HYDROXIDE BY KAOLINS[1]

By R. F. Geller and D. R. Caldwell

ABSTRACT

Amounts of NaOH absorbed by kaolins.—The amounts of sodium hydroxide completely absorbed by North Carolina, Georgia and Florida kaolins, without showing the presence of free alkali sufficient to color phenolphthalein are, respectively: 0.125%; between 0.100% and 0.125%; and between 0.225% and 0.250% of the dry weight of the clay.

Effect of time and temperature on absorption.—The absorption appears to be largely independent of time but increases with temperature.

Nature of the absorption process.—The experimental data can be expressed by the Freundlich adsorption isotherm thus indicating that the adsorption process belongs to the category of adsorption phenomena.

Introduction

The present work was undertaken for the purpose of determining the percentage of sodium hydroxide removed from solution by kaolin and to establish, if possible, whether the removal of the alkali represents a case of absorption or whether it is due to chemical combination under the assumption that we are dealing with a quasi-kaolinic acid. Such information is desirable in dealing with the deflocculation of kaolin in the purification process.

In this paper the term "absorption" will be used to designate the removal from solution of a dissolved substance by a solid, regardless of the mechanism by which this occurs. "Adsorption" may be considered as a special form of absorption, characterized by the accumulation of the dissolved substance upon the surface of the solid.

If an attempt were made to titrate the excess alkali in the presence of the clay, it would be found that no sharp end-point could

[1] Published by permission of the Director, Bureau of Standards. Received March 23, 1921.

be secured either with indicators or with a hydrogen electrode. This behavior is probably due to the fact that as the alkali in the solution is neutralized, the equilibrium with the clay is disturbed, not alone by the change in the alkali concentration, but also by the presence of the neutral salt produced. The above difficulties could probably be avoided by a direct measurement of the hydroxyl (or hydrogen) ion concentration of solutions of increasing alkali content containing the clay in suspension. Such measurements could no doubt be made by means of a hydrogen electrode. As opportunity offers it is hoped to investigate this method of study.

Experimental

The materials used were typical samples of washed Georgia, North Carolina and Florida kaolins. In the method employed by us, definite amounts of alkali were added to the clay and the solid matter was removed by centrifuging after standing for some time. The alkali was then determined in the liquid. The material to be tested was dried at 110° C and for each determination samples of fifty grams were used with an addition of 400 cc. of distilled water. After addition of the desired amounts of sodium hydroxide, the containers with the suspension were shaken mechanically for one hour and allowed to stand for 23 additional hours. The supernatant liquid and the suspended matter were then centrifuged in a Sharpless machine rotating at from forty to fifty thousand revolutions per minute. Although a liquid free from visible solid particles was obtained, it still probably contained some colloidal matter so finely dispersed that it would pass through filter paper. This solution was made acid by means of 0.01 normal sulphuric acid, and the excess of acid was then titrated in the boiling hot solution with 0.01 normal sodium hydroxide, using phenolphthalein as the indicator. The calculated amount of alkali necessary to neutralize all of the acid added, less the amount of sodium hydroxide required to neutralize the excess acid, is equivalent to the alkali left free in the solution after interaction with the clay. The sodium hydroxide absorbed is then found by subtracting this free alkali from the amount added to the clay. The following results were obtained:

TABLE 1

Amounts of NaOH Absorbed by 50 Grams of Kaolin from 400 Cc. of Solution

	NaOH added grams/liter	NaOH absorbed % of clay	NaOH absorbed expressed as % of NaOH added
A. N. Carolina kaolin.....	0.125	0.100	100.00
	.156	.125	100.00
	.187	.148	98.67
	.250	.192	96.00
	.312	.208	83.20
	.375	.229	76.33
	.437	.252	72.00
	.500	.254	63.50
	.625	.286	57.20
B. Georgia kaolin.....	0.125	0.100	100.00
	.156	.122	97.60
	.187	.146	97.33
	.250	.173	86.50
	.312	.205	82.00
	.375	.211	70.33
	.437	.231	66.00
	.500	.239	59.75
	.625	.265	53.00
C. Florida kaolin.....	0.125	0.100	100.00
	.250	.200	100.00
	.281	.225	100.00
	.312	.240	96.00
	.343	.257	93.50
	.375	.265	88.33
	.437	.281	80.29
	.500	.301	75.25
	.625	.356	71.20

The results for all the clays were found to check very satisfactorily. It will be noted that in all cases when small amounts of alkali are added, all of the reagent is absorbed by the clay, or at least insufficient is left in solution to be detected by phenolphthalein. With the North Carolina clay the centrifuged liquid was very pale yellow, indicating the presence of organic or inorganic matter dispersed as a colloidal solution.

It appears from the results for the Georgia kaolin that the absorption, in spite of the greater fineness of this clay, is less pronounced than with the other kaolins, indicating that the material

already contains absorbed matter. The centrifuged liquid differed in color from light to dark yellow according to the amount of free alkali remaining in the solution, indicative of an appreciable amount of organic and other substances of a colloid character. With the Florida clay the centrifuged liquid was a clear yellow in color. These results show that the absorption power of the Florida kaolin is decidedly greater than for either of the preceding ones. This would indicate greater fineness since, if the absorption is a case of adsorption, it is proportional to the specific surface. In using sodium hydroxide as the absorbed substance, there is, however, a possibility of chemical reaction with the clay owing to the acid nature of the latter, which complicates the situation.

Rate of Absorption.—In order to determine the rate of absorption, a suspension of 50 grams of the Georgia clay was allowed to stand with 400 cc. of solution containing 0.625 gram per liter of sodium hydroxide, for different periods of time up to 96 hours, and the following results were obtained:

Time in hours	0.25	1.00	24.00	72.00	96.00
NaOH absorbed per cent of clay	0.276	0.283	0.265	0.287	0.289

The maximum absorption therefore takes place quite rapidly and even after ninety-six hours the amount taken up is only 2.4 per cent greater than the quantity absorbed after one hour.

Effect of Temperature.—It is evident that in systems of this kind the absorption is also a function of the temperature. By allowing only one hour for the reaction, but raising the temperature to 90° C, the amount of alkali absorbed by Georgia kaolin from a solution containing 0.625 gram per liter of sodium hydroxide was 0.342% as compared with 0.265% under conditions of normal temperature. This marked difference appears to be due to chemical reaction of the alkali, which is to be expected. With Florida kaolin, under the same conditions, 0.41% of sodium hydroxide was absorbed at 90° C as compared with 0.356% at room temperature. The smaller change introduced by increased temperature, with the Florida clay, may be connected with the deviation from the normal curve (Fig. 1).

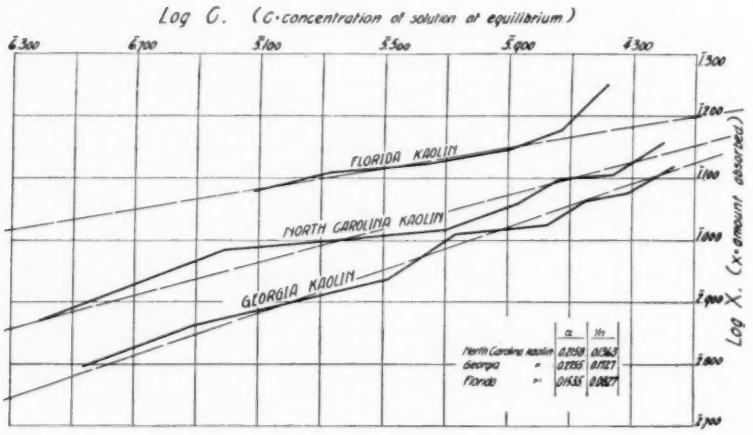


FIG. 1

The Absorption Isotherm.—The Freundlich equation for the absorption isotherm, $x/m = \alpha C^1/n$, in which x equals grams of NaOH absorbed by m grams of the absorbent, C the volume concentration of NaOH at equilibrium, and α and n are constants, was applied to the experimental data. The results obtained by plotting the logs of x and c are shown graphically in figure 1. It is evident that if the above equation holds the resulting curves must be straight lines. By comparing the plots obtained for each clay with the mean straight line, it will be found that while there are variations, the agreement in general is good. The Florida kaolin shows the straight line relationship particularly closely up to the higher concentrations of alkali, but then it departs sharply from the straight line. The constants, α and $1/n$, of the Freundlich equation for the three clays studied are indicated on the graphs.

It is believed that this field of study, employing other electrolytes, offers many possibilities for the more exact differentiation of the different types of clays, especially where the cruder methods of mechanical analysis fail. Thus the absorption of malachite green proposed by Ashley is a measure of the plasticity of clays, which is undoubtedly useful in estimating the relative specific surface of the materials, though to what extent such absorption

is influenced by electrolytes and non-electrolytes already absorbed remains to be seen.

The further study of absorption phenomena for different clays is suggested, especially with solutions involving no direct chemical action.

The writers wish to acknowledge the assistance of Mr. A. V. Bleininger in outlining this work.

BUREAU OF STANDARDS, WASHINGTON, D. C.

TESTING COKE OVEN REFRACTORIES[1]

By F. A. Harvey and E. N. McGee

ABSTRACT

General Requirements are stated for mat, bench walls, checker work, regenerator korbels, main flues, division walls, oven chambers and jamb blocks. The following *Tests* are described:—inspection, reheating tests on three qualities, bending test.

Requirements and specifications are discussed. The latter part of the paper deals with *Apparent density* and *Permanent expansion*. It is shown that the relation between them is a linear one and a chart is given. The average of thirty-nine determinations gives an apparent density, for Western brick, 0.016 higher than for Pennsylvania brick, due to the fact that the Western ganister is slower to transform than the Eastern.

Introduction

The proper testing of refractory materials requires a clear understanding of the conditions both ordinary and extraordinary, which the materials will be called upon to meet. The word "failure" applied to refractories has a very wide range of meaning. Under given conditions the average life may be only a few weeks, while under others it may be several years. We will, therefore, define "failure" loosely as a life considerably shorter than the average. "Failures" may be placed in three classes: (1) Due purely to a lack of understanding of ordinary conditions to be met; (2) Failure to take account of abnormal conditions—*i. e.*, too low a safety factor; (3) Faults of operation. due either to accident, ignorance, or carelessness. As illustrations of *the first*, we might cite the use of low heat duty clay brick, where high heat duty are required, or the use of silica brick where they are subjected to repeated rapid temperature fluctuations at a fairly low temperature; or the use of some home-made or patented cement or fire-mortar at a temperature higher than its fluxing point. To illustrate *the second*, the necessity of carrying the full steam load of a plant on two boilers on a four boiler

[1] Received March 10, 1921.

plant for short periods, or the high temperature which may be reached in the regenerators of a block of coke ovens, due to a break down in the reversing mechanism; or the possible increased temperature reached in the oven-chamber due to a breakdown in the pusher, coal or coke handling or larry cars, which prevents pushing ovens on schedule. For *the third*, we might cite running a coke-oven plant at a higher pushing rate than the material of construction will allow, or failure to correct hot spots due to leakage or excess gas. Many other illustrations might easily be cited. The testing engineer is concerned with all three classes of failures; the first he should eliminate entirely; the second is a balance between cost of materials and cost of possible repairs; and the third is a matter of education of the operators as to what the materials in his care will stand.

General Requirements

We shall attempt to state conditions for a modern regenerator plant, starting from the concrete mat. It is customary to use several courses of clay brick just above the mat. The temperature reached varies according to construction, but it is normally quite low, probably not over 600° C to 700° C. There are no temperature fluctuations to meet. The load is very high as the full weight of the battery is carried. Uniformity of size is essential.

Next come *the foundation walls*, or bench walls. It is customary to make these walls of silica brick. The temperature requirements are fairly low except in cases of severe leakage, due to wrong design. There is very little change in temperature. The brick must be thoroughly burned. Permanent expansion must be very low to prevent creeping of the substructure, spoken of below. The load is very high. Uniformity of brick and very thin mortar joints, to prevent settling, are essential. Silica brick are necessary, due to the fact that they will carry the heavy load without the gradual shrinkage which clay brick would show.

The *Checker work* of the regenerators usually consists of clay brick for the lower courses, silica brick for the top checkers. The temperature of the top checkers varies from about 700° C

to 1300° C. The lower checkers normally run from 450° C to 800° C, but have been known to reach 1300° C under abnormal conditions. It is evident that the lower checkers must have a high safety factor. Temperature fluctuations are not harmful to a silica brick as long as the lowest temperature reached is above approximately 400° C. For these reasons the Semet-Solvay practice, with use of silica for the top half of the checkers, seems very advantageous. Conductivity is also an important factor in a regenerator brick, and the greater conductivity of silica over clay brick gives an added reason for using as many silica checkers as possible. Strength is not an important factor and the brick need not be as hard burned as for other parts of the oven, provided room is left for expansion.

Regenerator Korbels.—The silica brick used in the korbel construction at the top of the regenerator chamber must be especially strong, but are not required to stand a very high temperature and are not subject to much temperature fluctuation.

Main Flues.—The main flues may run under the block as in Semet-Solvay ovens, or beside the block as in the Koppers design. It is Semet-Solvay's practice to make them of silica brick with a clay brick veneer. The clay brick absorbs the temperature fluctuations, due to reversing the draft, while the silica gives the necessary strength. The temperature is normally not over about 400° C, but a high safety factor is desirable.

Sole Flues.—Under the oven chamber comes the sole flue. In the modern Semet-Solvay regenerator oven, this is constructed entirely of silica shapes. It has to withstand nearly the same temperature fluctuations as the top checker brick of the regenerators, but at a slightly higher temperature. The silica must be well burned.

Division Walls.—Above the foundation walls in the Semet-Solvay oven come the division walls. These walls separate the oven chambers, making them independent of each other in heating, and carry the roof structure and charging car track entirely independently of the oven-heating flues. They act as huge reservoirs of heat, holding the flue temperature to a high

value when the oven is pushed and charged with fresh coal. The brick must be uniform in size, and high in strength and heat conductivity. Silica is used. It must be very well burned.

The Main Oven Chamber.—This requires great strength in the lining blocks, high burn and very good workmanship. The end blocks, *i. e., jamb blocks*, of the oven lining should be of clay to withstand the sudden temperature changes due to raising the door for pushing. They must be very hard burned to resist abrasion.

Above the oven chamber there are about six (6) to nine (9) inches of silica, which has no particular requirements except a good burn. Then come several courses of "B" quality clay brick, several courses of red brick, with possibly some insulating brick, and then the paving brick. The brick on the face of the oven above the door present a special problem, as they are subjected to the hot gases from the oven during pushing, and to weather conditions—rain or snow—the rest of the time. They should be dense to resist weather and of open structure to resist spalling. A middle course must be steered between the two extremes. In several types of ovens there are special problems—such as gas nozzle brick, damper brick, and so forth, with which the writers have had no direct experience.

Description of Tests

The tests to which the refractories are subjected are as follows:

1. Inspection—size, warpage, ring, bond, vitrification.
2. Re-heating tests, "A," "R" and "B."
3. Fusion point.
4. (*a*) Bulk density; (*b*) Apparent density; (*c*) true density; (*d*) porosity.
5. Bending tests, "A," "R" and "B."
6. Load test.
7. Crushing and modulus of rupture.
8. Spalling test.
9. Fineness.
10. Plasticity.
11. Conductivity.

Sampling.—If sampling is done by a trained inspector, samples should be taken to represent the carload. In case there is doubt of the quality he should take about six to the car. He should estimate the per cent brick represented by the various samples, if there is a marked difference in quality. The factors to be taken into consideration are degree of burn, grind and workmanship. For an untrained workman, one sample per thousand chosen at random should be set aside, from every carload, for the trained inspector. From these samples a few should be selected by the trained inspector and sent to the laboratory for test; the number depending on the quality of the brick. In case of doubt, a large number should be tested.

1. Inspection.—This includes measurement for size, degree of warp, ring under the hammer test and any departure from standard samples in color, bond, vitrification or workmanship.

The following instructions for mason foremen and inspectors are based upon an extensive experience in the testing of this class of refractories.

HOW TO JUDGE FINISHED SILICA SHAPES AND BRICKS

1st Cracks.—Cracks are of two kinds, (1) "Surface Cracks" or so-called "Slick Cracks," due to drawing the slick over the ganister in the mould. These cracks are seldom over $^1/_{16}''$ in depth and are not dangerous. (2) Body cracks. These may develop in burning, particularly where there is a sharp re-entrant angle in the shape. Usually they may be found by careful inspection, but the surest method is to tap the brick or shape lightly with a light hammer. This test should always be used on bricks which go into important places in the oven, particularly when any cutting has to be done. Bricks should have a clear ring; those with punky sound should be rejected unless brick have been exposed to the elements, in which case the moisture would give them a dead sound.

2nd Dimensions.—Undersized silica brick are likely to be poorly burned. In this case they will show more expansion when brought up to heat in the oven than a full size brick. For instance, suppose a front slab of the oven lining is $^1/_4''$ short and in

order to make the cover brick lie flat, the back slab is trimmed $^1/_4$". On coming up to heat the front slab will expand $^1/_4$" more than the back slab and frequently break the cover brick. Undersized brick should only be used where expansion is unimportant. They do not conform to specifications and may be rejected. Oversize brick may be punky, due to too rapid burning. If the brick is solid and has a good ring, being oversize will not hurt it unless this means cutting. Cutting should never be done if it can be avoided, as it weakens the brick. Probably the labor is less in gaging and sorting brick than in cutting.

3rd Workmanship.—Uniformity in size, sharp edges and corners, friability and plane surface are important points to be considered. Three or four shapes set on edge dry, one on top of the other, gives a good idea of quality of workmanship.

4th Color.—The color of silica bricks depends upon the conditions of burning, the amount of lime used for bond and the amount of impurities. Color can not be used in comparing bricks made by different makers, but may be used with caution on bricks from a single maker. The best and hardest burn on eastern ganister will be white with red "splotches" or spots. Western and southern ganister is darker and harder and when well burned will be nearer a uniform color. A brick showing a rust brown color or fire flash is frequently cracked, more often the interior structure is shattered and unless they have a true, clear ring under hammer test, should in no case be used.

5th Iron Spots.—Iron spots will not cause any trouble when thoroughly oxidized unless the iron has eaten a large hole in the brick.

6th Density.—Laboratory tests may be made at the plant to determine approximately the degree of burn in case information is desired before tests can be obtained from the testing laboratory. Copies of the method for determining apparent density may be obtained from Syracuse.

7th Laboratory Tests.—Other tests, such as reheating test, chemical analysis and porosity should be made at the testing laboratory if any question remains to be decided.

2. The Re-heating Test.—This is conducted in one of the four gas-fired furnaces shown in figure 1. When the samples have been selected for test, they are carefully examined for workmanship, ring and vitrification, if a clay brick. All dimensions are taken and the sample weighed. From these measurements the bulk density is calculated. The sample is then broken in half and on one piece linear measurements are made with a

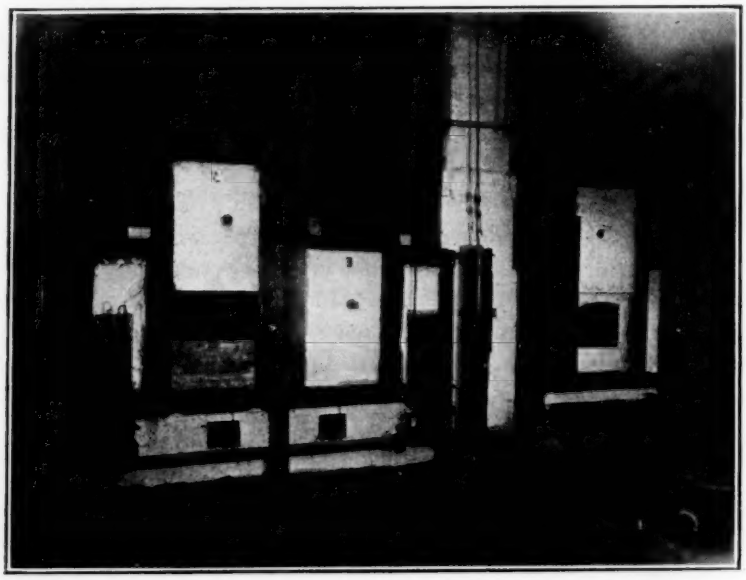
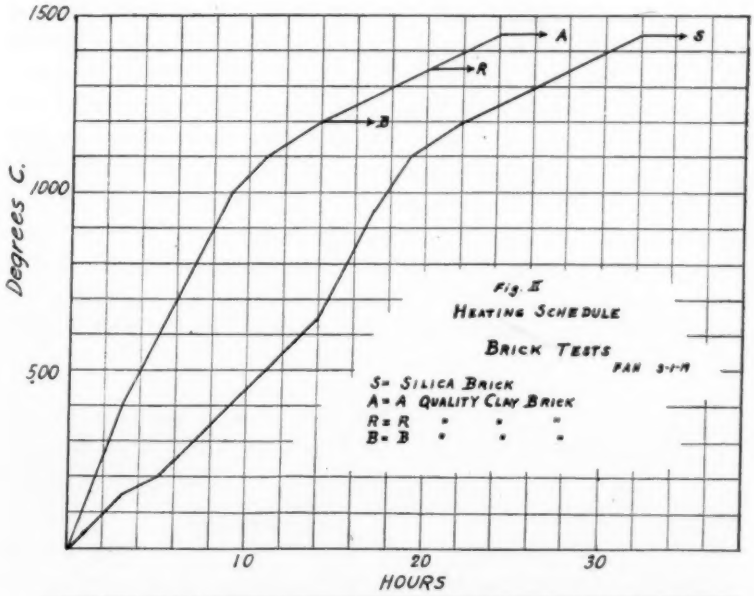
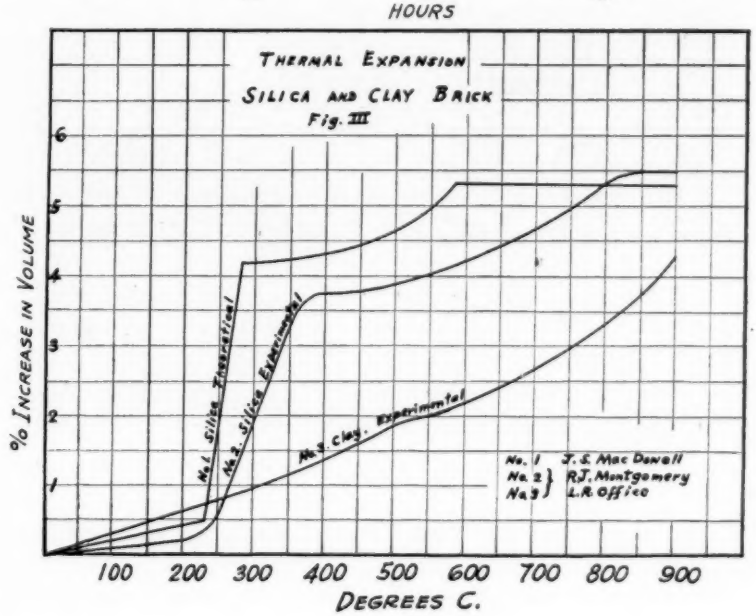


FIG. 1.—Three of the large testing furnaces. No. 2 is fitted up for spalling tests.

vernier caliper or the volume determined by displacement. The half samples are set in the furnace and a diagram made showing the location of each sample as it is set. The gas is lighted and turned on gently. The temperature is controlled by hand regulation of the gas valve and the heating curve shown in figure II followed as closely as possible. These curves have been determined by long experience and represent the maximum safe speed for heating. Curves A, R and B give the schedule for clay


1500
1000
500
Degrees C.
A
S
R
B
Fig. II
Heating Schedule
Brick Tests
PAH 3-1-19
S= Silica Brick
A= A Quality Clay Brick
R= R " " "
B= B " " "
10
20
30
HOURS


Thermal Expansion
Silica and Clay Brick
Fig. III
% Increase in Volume
1
2
3
4
5
6
No. 1 Silica Theoretical
No. 2 Silica Experimental
No. 3 Clay. Experimental
No. 1 J. S. Mac Dowell
No. 2 } R.J. Montgomery
No. 3 } U.S. Office
100
200
300
400
500
600
700
800
900
Degrees C.

brick and S for silica brick. It will be noted that the rate of heating is about 50 degrees per hour until 650°C is reached, after which the rate is increased. Above 1100°C the rate is again slower, but this is merely due to the fact that the furnace will not conveniently heat much faster. The little slow up just before 200°C merely calls the attention of the operator to that particular point and insures careful heating from 200° up through the transition from alpha to beta Crystobalite (see Fig. III). Figure III is taken from data by Montgomery & Office, *J. Am. Ceram. Soc.*, and the calculation by MacDowell. It shows clearly the necessity of slow heating while the large volume change from 200° to 400°C is taking place.

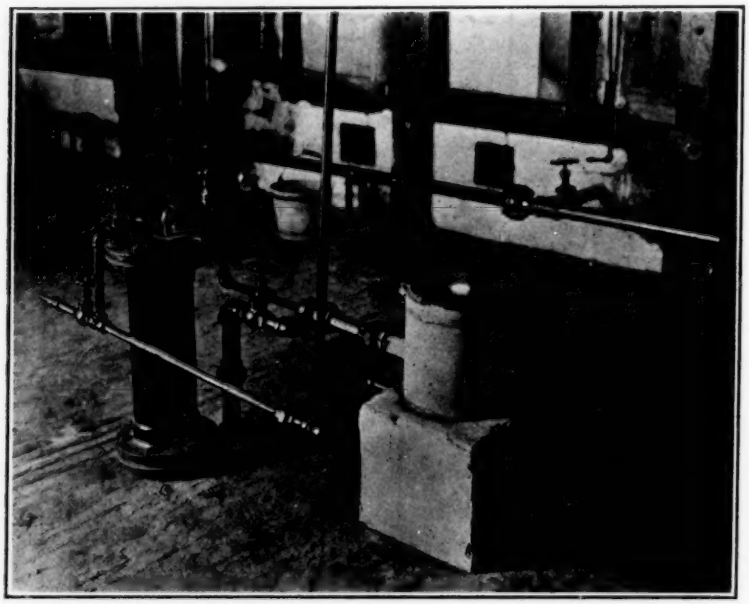


FIG. IV.—Pot furnace for fusion tests.

After reaching the maximum temperature, the temperature is maintained as nearly constant as possible for 72 hours. The gas is then shut off, the furnace kept closed and allowed to cool.

The door is cracked open at 18 hours for clay brick and not under 30 hours for silica, being opened wide six hours later. The temperature is recorded during the entire test by a recording pyrometer. It has not been possible so far to find a pyrometer tube impervious to gases which will consistantly stand 1450°C for 72 hours. For this reason two thermocouples are used. Two silfrax protection tubes are cemented into the back of the furnace, one above the other. The upper projects seven inches into the furnace chamber and the lower about two inches. A platinum thermocouple, in a fused quartz tube, is inserted in the upper tube and allowed to remain there ten minutes to get the actual temperature of the furnace. This couple is used for the first part of the heating-up period and two or three times during the test. A second platinumcouple in a vitrified porcelain tube is inserted in the lower silfrax sheath. This couple indicates a temperature about 100°C lower than the true temperature of the furnace. This is due to the fact that the silfrax sheath, which projects only a short distance into the furnace, carries heat away fast enough to keep it at a lower temperature than the hot gases, just as a fire-brick wall does not attain the temperature of furnace gases. The temperature is controlled by this couple, which also makes a continuous record of the temperature. The record by the upper couple amounts to a calibration of the lower couple during the run. The calibrating couple is kept in first-class condition by being frequently annealed. It is checked by comparison with a new couple or by taking the temperature of the brick while under test with a Leeds and Northrup optical pyrometer.

The furnace chamber is explored from time to time by means of the optical pyrometer, to insure its uniformity of temperature. Orton cones have also been used at times to check this point. Any variation in temperature is corrected by changing the holes in the gas burner pipe or altering the opening for waste gases in the floor of the furnace. The front row of bricks is always about 50°C lower in temperature than the others and for this reason a blank row on which no test is made is set in front. If the temperature goes wrong, the test is rejected.

After the furnace has cooled, the brick are removed and again measured with vernier calipers or by displacement. From the two sets of measurements, the per cent change in size is calculated. Typical reports are shown in Reports V and VI.

The "A" test is run at 1450°C, the "R" test at 1350° and the "B" test at 1250°C, each for 72 hours after attaining the full temperature.

3. Fusion Point.—This test is run according to the method C-24-20 of the American Society for Testing Materials. It is used on clay brick, silica cement, fire-clays and mortars.

4. Density.—Bulk density is determined as described above. It is of value in showing uniformity of product and to a slight degree gives an indication of spalling tendency. Apparent density is determined by the method described by Ross, and discussed in *J. Am. Ceram. Soc.* A vacuum of at least 20 inches of mercury should be maintained during the boiling. This can easily be done by means of a rotary oil (Cenco-Nelson) vacuum pump. A filter pump is not satisfactory. True density is determined in the usual manner, with the specific gravity bottle. Kerosene works better than water in the bottle, but this method has not yielded as consistent results as the apparent density. The apparent density method is very valuable in connection with silica brick. A study of this method is given below. Porosity is determined by method C-20-20, American Society for Testing Materials.

5. The Bending Test.—This test is used on clay brick for "A," "R" and "B" quality. In making this test the clay brick is supported on other brick, at both ends, seven inches in the clear, loaded with a five-pound cut fire-brick in the center, set on end. This test is conducted in connection with the reheating test and is run at the same temperatures and for the same length of time. This test is practically equivalent to the load test (No. 6) and need not be used where the load test is made. When a brick is being tested for shrinkage, it is usually convenient to run the bending test at the same time, otherwise the load tests saves time and gas.

6. The Load Test.—The test used is that described in Methrod C-16-20, American Society for Testing Materials.

7. Cold and Hot Crushing Tests and Modulus of Rupture.—These are conducted according to the standard methods.

8. Spalling Tests.—These are conducted according to the methods described by Howe and Ferguson. "A Study of Spalling" *J. Am. Ceram. Soc.* We prefer dipping in water to cooling by blast, as it is much easier to maintain standard conditions. an air

9. Fineness.—On fire-clay and silica cement *fineness* is of considerable importance. The test is made by sifting dry in a Ro-Tap Sieve-shaking machine for ten minutes. The automatic time stop and mechanical shaking give exact results if the sample is dry and the sieves standard and clean.

10. Plasticity.—To determine this we use a pail test. The cement or fire-clay is mixed up to the consistency of dipping mortar, and allowed to stand 24 hours. If after this time it has not settled so as to cake in the bottom of the pail, our experience shows that it will spread smoothly and easily and not give trouble by settling in the mortar boxes.

11. Conductivity.—Comparative tests have been made by building the roof of one of the test furnaces shown in figure I, the first of one kind of brick then of another, and measuring the temperature gradient through the roof at regular intervals during one of the "A" tests described above. This method is recognized as being very crude, but it has the advantage of duplicating actual operating conditions very closely for some cases.

Requirements and Specifications

All *silica brick* and shapes must pass the "A" reheating test, showing not more than 1.6% average permanent linear expansion. For regenerator checkers expansion up to 2% can be allowed. Lime content should not be specified until more complete data, on the effect of lime, are available. Alumina should not exceed 1.65%. For fineness of grind, 97% should pass a 1/4" mesh screen. All Class No. 1 silica bricks should have a

modulus of rupture not less than 500 lbs. and cold crushing strength not less than 1600 lbs. per sq. in. Class No. 2, a modulus of rupture not less than 350 lbs. and cold crushing strength not less than 800 lb. per sq. in. Class 1 bricks should be used in bench walls, korbels, and oven linings. Shape brick should not have variations in dimensions greater than $^1/_{16}$″ to the foot for brick under 12″; and $^1/_8$″ to the foot for larger shapes. Visual inspection and the hammer test should eliminate cracked and badly warped shapes.

For *clay brick*, in the reheating tests "A," "R" and "B"—swelling must not be greater than 1%, nor shrinkage greater than 1.6%; bending tests not greater than $^3/_8$″ for "A" tests and $^1/_4$″ for "R" and "B" tests. Dimensions should not vary more than $^1/_8$″ from standard dimensions if under 12″, nor more than $^3/_{16}$″ to the foot if over 12″. In special cases one or more dimensions may be important or unimportant, in which case it may be shown on the shape B/P. When ordering brick, the purchaser should state whether hand-made or machine-made brick are desired, as the same clay mixture may give brick suitable only for very different service by the two methods of manufacture. "A" quality brick are used in boiler settings, stocker arches, etc. "R" quality brick for the lower deckers in the regenerators, main flue linings, sole flue or recuperator ovens and jamb brick. The "B" quality brick is used on doorlining shapes, for lower mat brick, top fill and oven face brick.

Silica cement must have a fusion point as high as cone 270 must all pass a 30-mesh screen on the fineness test; and must pass the pail test. It must not contain over 25% plastic clay.

"A" quality *fire-clay* must spread easily and smoothly with a trowel, all pass a 14-mesh and 95% a 20-mesh screen and fuse not lower than cone 28. "B" quality fire-clay may have a fusion as low as Cone 20. All "A" and "R" quality clay brick must be laid up with "A" quality clay. "B" quality clay may be used in laying up "B" quality brick.

Apparent Density and Permanent Expansion

The method given under (2) for testing silica brick gives very accurate and reliable results and has resulted in a large saving

of money for repairs. Figure V shows the difference which may exist between tile which are thoroughly burned and those underburned. In each case the lower part of the tile represents the tile as received from the manufacturer and the upper part a section which has been cut off and subjected to the reheating test. Note that number 1 shows practically no permanent expansion, while 2 and 3 show nearly $^1/_2''$ in 9 inches. Tile like number 3 failed repeatedly in the ovens. For the brick in the lower bench walls the importance of this point can not be overestimated. In a wall 38 feet to 40 feet long, with the brick laid almost end to end,

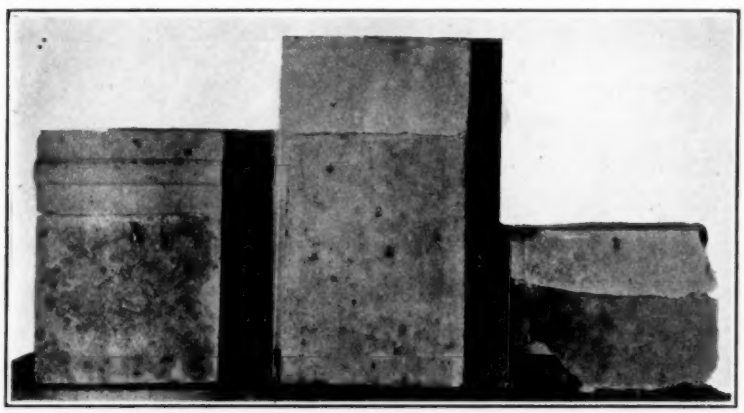


Fig. V—Showing expansion of brick on reheating test. Note that 2 and 3 expanded nearly $1\frac{1}{2}''$ while 1 remained practically unchanged.

a permanent expansion of two and one-half per cent means an increase in length of twelve inches. This increase does not take place all at once on starting the ovens, but is very slow. It lasts perhaps over ten years or more, at the low temperatures reached in this part of the oven. In spite of this low temperature the brick does grow. This gradual growth results in opening cracks in the upper structure which will eventually cause trouble. We have tested a number of brick which have been in service several years and never found any permanent expansion. The cracks may be closed by carbon deposits while the battery is in operation and yet make it impossible to start up again after

shutting down cold. In view of the great importance of the permanent expansion, and also the advantages obtained by a more rapid test than the reheating test, a large number of experiments have been made to obtain the relation between permanent expansion and apparent density. It was at once evident on starting the tests that a difference exists between the apparent density of brick made from Eastern, or Medina, and from Western, or Baraboo, quartzite. A difference also exists in the permanent expansion. After a large number of tests it seems probable that it is not commercially practicable to burn Western quartzite so that it has as little premanent expansion as the Eastern. Samples of Western bricks have been tested, however, which show. the

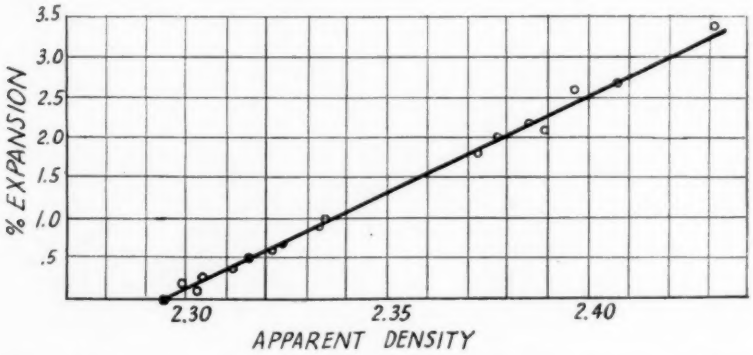


FIG. VI.—Pennsylvania silica brick; apparent density *vs.* per cent expansion on reburning test.

same apparent density as Eastern bricks. There have been only some half dozen samples out of about a hundred for which this is true. These same six samples show almost no permanent expansion. In connection with the work of the Committee on Refractories for American Society for Testing Materials, a number of green brick were obtained and burned in our testing furnaces. A temperature and time which leaves no permanent expansion in Eastern bricks leaves nearly 1 per cent in the Western bricks. The apparent density of the Western brick could not be brought down to the same value as the Eastern by three burns in some cases. Figure 6 gives the relation between ap-

Column 1	Column 2	Column 3	Column 4	Column 5
A	1.0	2.374	2.334	.040
A	.0	.345	.334	11
A	.0	.373	.334	39
A	.0	.341	.334	07
B	.2	.364	.343	21
B	.2	.372	.343	29
A	.3	.345	.347	+02
A	.3	.369	.347	22
B	.4	.362	.351	11
A	.5	.390	.355	35
A	.6	.368	.360	08
B	.8	.385	.368	17
A	.8	.396	.368	28
B	.9	.384	.373	11
A	2.0	.370	.377	+07
A	.1	.429	.382	47
A	.2	.414	.386	28
B	.5	.436	.399	36
C	0.2	.308	.302	06
C	.4	.328	.310	15
B	.4	.329	.310	18
C	0.5	2.329	2.314	0.015
C	.6	.331	.319	12
B	.8	.327	.327	00
B	.8	.332	.327	04
B	1.2	.350	.343	07
B	.2	.346	.343	03
B	.8	.387	.368	19
B	.8	.396	.368	28
B	.9	.387	.373	14
B	.9	.372	.373	+01
B	2.0	.397	.377	20
B	.0	.385	.377	08
B	.0	.392	.377	06
B	.2	.408	.386	22
B	.2	.420	.386	33
B	.3	.416	.390	26
B	.3	.388	.390	+02
B	.3	.396	.390	06
			Average	0.016

parent density and permanent expansion for bricks from eastern quartzite. It seems to be quite accurately a straight line. A few values obtained fell clear off the line, but they were so few in comparison with the total number that they were certainly due to experimental error. Some of the points shown on the diagram represent average density for eleven bricks, all of which showed the same permanent expansion. The curve represents the results of about 150 determinations. In order to find the difference between the Eastern and Western density, the following table was made. The first column gives the manufacturer; the second the permanent expansion on the reheating test; the third the apparent density; the fourth column gives the apparent density of an Eastern brick with the same amount of permanent expansion and the last column gives the difference between the Eastern and Western densities.

The average difference is 0.016 for the thirty-nine determinations.

By the second method, burning the green brick from Eastern and Western manufacturers, the average density of thirteen Eastern brick was 2.306, and for twelve Western brick was 2.339, the difference being 0.033. After repeated burnings of three Western brick, the average density decreased to 2.320, a decrease of 0.019. The average density of four Western brick burned in an Eastern kiln, was 2.340, while the average of the Eastern brick burned under the same conditions was 2.31 to 2.32.

The general conclusion is that the apparent density of Western brick, which it is practicable to reach, is from 0.016 to 0.02 higher than that of Eastern brick. Equal densities mean, however, that the same amount of permanent expansion will eventually come out of the brick, if the service is long enough.

In conclusion, we wish to acknowledge the fact that the reheating tests and bending had their original development under Dr. L. C. Jones, Chief Chemist of the Solvay Companies and that to him is due the principle which underlies, *viz.*, that a long period of heating is necessary to develop the qualities of a clay brick.

UNITED STATES REFRACTORIES CORPORATION
AND SEMET-SOLVAY COMPANY

Discussion

DONALD W. ROSS: The data of this paper are apparently in entire agreement with the following data of the U. S. Bureau of Standards Tech. Paper 116, notably figures 16 17, 18, 19, 20 and 21, and tables 7, 8, 16 and 18. The 1500°C data of table 7 of the latter bear out the data of figure xl of the present paper and the writer believes the method used in plotting the results shown in this figure is unique. Such a method of plotting the results has the advantage that the relation between specific gravity and the permanent increase in exterior volume of commercial silica brick occasioned by heating them sufficiently to cause the remaining quartz to be transferred to the lower specific gravity forms is apparent at a glance. The authors state that the curve as shown is obtained largely from data of tests on brick made from Medina quartzite. Our own data (referred to above) indicate that by a given heat treatment the quartz contents of brick made from Baraboo quartzite are less transformed to low specific gravity forms than are those of brick made from Medina quartzite. We further found that brick made of friable quartzites or those high in fluxes, other than iron, are, on firing, apt to result in a very porous product, which shows an excessive exterior volume expansion. Materials of this latter type could hardly be expected to conform to the curve shown in figure 11. However, such materials are easily identified by their friableness.

It seems worthy of note that from the transverse strength data of Tech. Paper 116 (Table 21), 500 pounds per square inch was arrived at as a desirable value for minimum strength of heavy duty brick and that from entirely different data and working separately, the authors have arrived at the same value.

With reference to the percentages of fluxes permissible in silica brick, the writer believes we will do wisely by adhering to McDowell's[1] limits—for quartzite 96 to 98 per cent SiO_2, combined percentages of iron and alumina 2.5 per cent, and less than 0.5 per cent alkalies, for the limits for CaO in the fired brick set at from 1.5 to 3.00 per cent.

[1]McDowell, J. S., "A Study of the Silica Refractories," *Am. Inst. of Mining Engineers*, Bull. **119**, 2009.

Baraboo brick sample number 18, table 16 of Tech. Paper 116, which received 9 years service in a by-product coke oven, had the unusually low porosity of 19.94 per cent. It seems probable that with bricks from the slow transforming Baraboo quartzite trouble caused by expansion in use due to further transformation of quartz to low specific gravity forms, may be at a minimum, and that with very slow transformation in extended service there may be a slight decrease in porosity, thus in part offsetting the increased value of the silica and tending to further minimize this danger.

The heating schedules (Figs. 2 and 3) shown in the present paper in conjunction with the method of measuring the flow of the heat through crowns, should be of interest to persons using glass tanks which have silica crowns. For such heating curves in conjunction with the conductivity of silica brick and similar information for clays brick should eventually lead to the establishment of a minimum safe rate heating schedule for such tanks.

CERAMIC ABSTRACTS

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General and Miscellaneous

1. Drying by electrically superheated steam. J. KARRER. *Engineering*, **110**, 821–2 (1920).—Owing to the scarcity of coal in some sections of Europe during the war it was found profitable to use electricity as the source of heating energy in drying. In the method described, the air in the oven chamber is kept circulating by fans, and the water vapor driven off from the material is superheated; greater thermal efficiency was obtained than by drying with hot air. Excellent results were obtained in the drying of *foundry molds and cores*, and in drying peat and vegetables; vegetables dried in this manner retain their natural color. DONALD W. MACARDLE. (*C. A.*)

2. Diatomaceous earth. NORRIS GOODWIN. *Chem. Met. Eng.*, **23**, 1158–60 (1920).—A resumé of the history, occurrence, properties and uses of diatomaceous earth, accompanied by an extensive bibliography.
W. C. EBAUGH. (*C. A.*)

3. Permutite. H. VOGTHERR. *Z. angew. Chem.*, **33**, I, 241–3 (1920).—A general review of the history and development of base-exchange processes. V. concludes that the active exchangeable bases are imbedded in the porous structure of the zeolites, in whose fine capillaries the exchange action takes place. The silicate itself, whether composed of silica alone or in combination with alumina or iron oxide, does not play any function in the exchange of bases except to furnish a medium of suitable physical nature. Methods of prepn., and phys. and chem. properties are given. Patents are referred to.
G. C. BAKER. (*C. A.*)

4. Talc and soapstone. R. B. LADOO. *Eng. Min. Jour.*, **111,** 161 (1921). —A short resumé of the talc industry in 1920. D. D. SMYTHE.

5. The mica industry. J. V. LEWIS. *Eng. Min. Jour.*, **111,** 158.—A short resumé of the mica industry in 1920. D. D. SMYTHE.

6. Barite. J. B. PIERCE, JR. *Eng. Min. Jour.*, **111,** 155.—A short resumé of the barite industry in 1920. D. D. SMYTHE.

7. Monazite. H. C. MEYER. *Eng. Min. Jour.*, **111,** 158.—A short resumé of the monazite industry in 1920. D. D. SMYTHE.

8. The domestic talc situation. ANON. *Eng. Min. Jour.*, **111,** 313.—A short general discussion of the United States talc industry in 1920 based on statements of R. B. Ladoo of the U. S. Bureau of Mines. D. D. SMYTHE.

9. The non-metallic mineral industries of the United States. R. B. LADOO. *Eng. Min. Jour.*, **111,** 215–221.—A general discussion emphasizing the importance of the non-metallic mineral industries of the United States. D. D. SMYTHE.

PATENTS

10. Vesicular materials and compositions. C. W. BOYNTON. Brit., 153,030, Apr. 16, 1919. A cellular product which is of low apparent sp. gr., a non-conductor of heat and electricity, free from laminations, and substantially impervious to H_2O is obtained by reducing *clay or shale* to a uniformly fine condition, and treating it in a dry, plastic, or slurry state under gradually increasing temp. until the mass softens and swells owing to the generation of gas from some of its constituents. A suitable clay contains SiO_2 49 parts, Al_2O_3 21 parts, Fe_2O_3 11 parts, C 2 parts, and negligible quantities of CaO and MgO. Generally, the clay or shale should be rich in metallic oxides, compds. of C, S, Na, K, or the like, the nature and proportions of flux and gas-generating ingredients being preferably such that the material softens at the same temp. as the gas is generated. Additions or subtractions may be made to ensure this. Excess of Fe, CaO and MgO should be avoided. The material is ground and may be used dry, or as slurry, or it may be made into a plastic mass and molded, in which case it is advisable to preheat the articles to drive off superfluous H_2O. The temp. of burning varies; it may be as low as 1040°. If the product is to be used for insulation or as an aggregate for concrete, oxidation of the surface during burning should be avoided. The product may be preformed into slabs, tiles, or the like or crushed and added to cement. The invention is distinguished from those in which clays, shales, slates, and the like are heated to produce porous masses. (*C. A.*)

11. Treating clay. P. SCHIDROWITZ, W. FELDENHEIMER and W. W. PLOWMAN. Brit. 153,861, June 2, 1919.—A process for the treatment of clay comprizes suspending the clay in H_2O with the aid of a deflocculator such as Na_2CO_3 and then, before any settlement takes place, evapg. the whole suspension to dryness. The clay may be first mixed with sufficient H_2O to give a pasty mass and then sufficient deflocculator added to produce fluidity, with

or without further addition of deflocculator until the fluidity decreases; or the clay may be directly worked up with H_2O and deflocculator. The clay may be first purified, *e. g.*, by one of the processes described in 106,890 (*C. A.*, **11**, 2607) or 121,191 (*C. A.*, **13**, The 647). product may be used for incorporation with rubber. (*C. A.*)

Apparatus and Instruments

12. A new study of the leucoscope and its application to pyrometry. IRWIN G. PRIEST. Bur of Standards. *J. Optical Soc. Am.*, **4**, 448–95 (1920).—The leucoscope is an app., originally suggested by Helmholtz, in which, by polarization, the entering light is sepd. into 2 complementary parts, which can be made equal in their effect on the eye, and therefore of the same color as the original. For white light one complementary part will contain mainly yellow and blue, the other red, green, and violet. In practice the match is not perfect; one complementary is yellowish, the other bluish, but they can be made equally red. The necessary division of the light depends on the spectral sensitivity curve of the eye; when the character of the light changes, the setting of the instrument will have to be changed to make a match. The leucoscope can thus measure *color temp.* and can be used as an *optical pyrometer* which requires no auxiliary app., either elec., or a comparison source of light. Priest refers to an article by Koenig (*Ann. Physik.*, **17**, 990 (1881)) for a description of the instrument; he reports a test of its efficiency He finds that there is a difference in the readings of diff. observers, but the calibration curve detd. for any one does not change appreciably, not even when the observer is feeling unwell; the av. agreement reached with an imperfect instrument is about 15° at 2000°K., and better at lower temps., though over 100° at 5000°. The instrument was further studied, as well as its application in finding the color temp. of light sources, illustrated by daylight.

W. P. WHITE. (*C. A.*)

13. Note on the measurement of the density of minerals. L. H. ADAMS. Geophys. Lab., *Am. Mineral.*, **6**, 11–12 (1921).—The marked advantages of a *flat-top pycnometer* for measuring ds. are pointed out, and brief details of manipulation given. The wt. of the app. filled with liquid can be detd. to within 0.1 mg., which implies an accuracy of about 0.0001 in the d. of an ordinary solid. E. T. WHERRY. (*C. A.*)

14. Reversible mercury manometer with dampened oscillations. PIERRE MENARD. *Compt. rend.*, **171**, 1129–30 (1920). D. W. MACARDLE. (*C. A.*)

15. Separation of slimes from liquids by centrifuging. BERTHOLD BLOCK. Charlottenburg. *Chem. App.*, **8**, 3–5 (1921); 3 cuts.—This is the 5th supplement to B.'s article (*C. A.*, **14**, 1872) in which he considers "the combination of the unperforated centrifugal drum with a filter." J. H. MOORE. (*C. A.*)

16. The technic of the filtering drum. LEONCE FABRE. *Industrie & chimique*, **7**, 346–9 (1920).—A description of the construction and method of

operation of the Zenith filter, and of the advantages which it presents in filtering slurries in the chem. industries (caustification of Na_2CO_3, manuf. of $NaHCO_3$, cement ind., etc.). A. P.-C. (*C. A.*)

17. Static notched-bar testing machine. ANON. *Chem. Met. Eng.*, **23,** 1180 (1920).—If a notched bar specimen is broken slowly by static pressure the work expended is comparable to that measured by a dynamic impact machine, and is much more effective in distinguishing between brittle and ductile metals. J. C. W. Humphry's app. operating on this principle is described and illustrated. By its use a curve is obtained plotted in foot-pounds and radians as axes, and the total energy absorbed in breaking the test piece can be calcd. from the graph, or can be obtained automatically by an integrating device fitted to the machine. W. C. EBAUGH. (*C. A.*)

18. Distance-reading thermometer. ANON. *Engineering*, **110,** 736–7 (1920).—An instrument of great accuracy constructed by Messrs. Negretti and Zambra of London. Errors due to temps. of the capillary connecting the bulb with the indicator are eliminated by making the capillary of material of high expansion and running throughout its length a wire of material of low expansion. The space not occupied by the wire contains the working liquid, and the vol. of the wire and liquid and the capacity of the tube are so calcd. that for a given change in temp. the change in vol. of the liquid is the same as the change in space it can occupy. The indicator is a Bourdon gage with all gears and levers eliminated, and having a bimetallic strip to compensate for variations in its temp. The error due to the height of the bulb with respect to the indicator is eliminated by a device for adjusting the zero.
G. W. STRATTON. (*C. A.*)

19. A substitute for Thoulet's solution. A. THIEL AND L. STOLL. Marburg. *Ber.*, **53,** 2003 (1920).—In the detn. of d. by the method of suspension, the aq. solns. most used are those of potassium mercuric iodide (Thoulet), and barium mercuric chloride (Rohrbach). The authors propose the use of $Pb(ClO_4)_2$ in place of these. The soln. is prepd. by treating perchloric acid with Pb carbonate and warming. The satd. soln. at 15° contains about 78% of $Pb(ClO_4)_2$, and its d. can be found accurately to the third decimal place with a Westphal balance. The d., 2.6, is not such as to make this soln. a complete substitute for the others, yet it covers a wide range and is relatively cheap. R. E. HALL. (*C. A.*)

PATENTS

20. Silica-washing apparatus. R. H. MOORE. U. S., 1,366,582, Jan. 25. The app. is adapted for washing a mixt. of silica 65 and clay 30 parts to obtain nearly pure silica. (*C. A.*)

Refractories and Furnaces

21. Swedish electric pig iron furnace. JONAS HERLENIUS. *Chem. Met. Eng.*, **24,** 108–12 (1921).—The furnace consists of a wide melting chamber or crucible above which is a shaft with a bell-charging apparatus at the top.

The shaft is designed in accordance with the general practice for common blast furnaces except for a recent tendency to widen out the lower section, making the diameter of the shaft at its junction with the crucible even larger than at the bosh. The entire *brickwork* and shell-plate of the shaft are *suspended independently of the crucible* and make a flexible, water-cooled joint with the roof of the crucible. The shaft is lined with fire-brick to a thickness of 18 in. for the upper and middle sections and about 14 in. for the lower. The crucible is cylindrical and is usually lined with fire-brick, although rammed-in coke and waste electrodes have been used with success. The crucible roof is of fire-brick of special shape. Through this roof the electrodes are inserted at an angle of 65° with the horizontal. A portion of the waste gas taken from openings in the throat is returned to the furnace and forced into the space between the charge and the roof through tuyères which point upward to blow the gas directly underneath the roof in order to cool it. The vol. of the circulating gas is const., so the gas formed during the process is available for auxiliary heating. This gas has a high B.t.u. value (258 B.t.u. per cu. ft. dry gas). The electrodes are of amorphous C, 4 to 8 in no., round (24 in. in diameter), and jointed for continuous feed. Electrode consumption has varied from 11 to 19 lbs. per ton of pig produced. As the power input is regulated by changing the transformer voltage, there is no need for electrode adjustment, except as they are consumed. The electrode holders, elec. contact clamps, the flexible joint between shaft and crucible, the tap-hole, and the tuyères are all water-cooled. There is a water-spray device for the entire shell of the crucible and the crucible roof is cooled by an air blast. The necessary elec. equipment is described. The transformer secondary voltages required for operating are 55–110 v. for charcoal or 35–70 v. for coke furnaces. There are installations operating on 25- and 50-, as well as 60-cycle a. c. In starting the furnace it is preheated for 2 to 3 weeks with a wood or coke fire in the crucible. Then 2 to 3 tons of coke and about 20 charges of coke, ore, and lime are shoveled into the crucible through the electrode holes and the electrodes inserted. The shaft is filled with mixed ore, lime and coke, and finally with charcoal with slowly increasing ore content. The current is then switched on, but the gas circulation is not started until about 2 days later. The charges contain 50–60% of Fe. The consumption of charcoal amts. in general to only 35–40% of the requirement in a common blast furnace. During 1918 the av. consumption of charcoal in all Swedish blast furnaces was 55.6 hl. per ton of pig, whereas in the elec. pig-Fe furnaces it amounted only to 24.8 hl. per ton. Few data are available as to the operation of these furnaces on coke (Stig, *C. A.*, **14**, 2752). Elec. pig-Fe is more thoroughly deoxidized than pig from the common blast furnace and, therefore, requires less Si and Mn to be suitable for the open hearth. Fe and slag are tapped from the elec. furnace at a lower temp. than from the blast furnace, but with an ample power input the temp. can be increased. There is no trouble in producing a pig high in C and Si and with a gray fracture. Desulfurizing in usual practice is less than in the ordinary blast furnace, owing to the lower temp.

This is overcome in recently installed high-power furnaces. About 2600 kw. hrs. are consumed per metric ton of pig-Fe produced. L. JORDAN. (*C. A.*)

22. Heat modifies acid furnace reaction. J. W. GALVIN AND C. N. RING. *Foundry*, **49**, 72–4 (1921).—The acid elec. steel furnace in foundry practice is considered. The efficiency of the furnace depends largely on the method of building up the bottom and the shape of the bottom. It should be burned in layer by layer and should have steep sides (cup-shaped rather than saucer-shaped) in order that the charge, both before and after melting, may be more directly under the arcs and subjected in larger part to direct flow of the current and, therefore, heated by internal resistance of the metal rather than by radiation from the arc and conduction from the center of the bath alone. Time and current can also be saved by using scrap that forms a compact mass. When such scrap is not available it is of advantage to leave some liquid metal in the furnace after each run and as quickly as possible throw in the new charge. The whole mass will then tend to weld into a solid body. After the charge is molten the slag should be kept thin by the addition of small amts. of Fe-ore from time to time. The control of the Si content of the product of the acid elec. furnace is most difficult. At the temp. of the open-hearth furnace SiO_2 is not reduced by C, but at the higher temp. of the elec. furnace this reaction does take place and the Si is absorbed by the metal bath. It is probable that Fe also has a reducing effect on SiO_2 under these conditions. This trouble is avoided and oxidation of the metal is kept down by holding the temp. of the metal to open-hearth temps. until the furnace reactions are as nearly complete as possible and then rapidly increasing the temp., and tapping at once before the high temp. reactions have time to go very far.
LOUIS JORDAN. (*C. A.*)

23. Possibilities of gaseous heating. W. N. BOOTH. *Gas J.*, **153**, 223–7 (1921); *Gas World*, **74**, 77–8 (1921).—The utilization of gas in relation to industrial furnace heating is discussed. Theoretical consideration is given to such problems as calorific intensity of various fuels and its relation to the thermal efficiency of a furnace, and loss of heat through furnace walls and its prevention. Thermal efficiencies of furnaces have been very low, av. only about 18 to 20%, but improvement is being made and efficiencies of 50% are predicted. J. L. WILEY. (*C. A.*)

24. The development of the vertical (gas) furnace. F. DOLLE. *Het Gas*, **40**, 207–11 (1920).—Summary. NATHAN VAN PATTEN. (*C. A.*)

25. A novel core oven. STEPHEN B. PHELPS. Pittsburgh. *Metal Ind.*, **18**, 503 (1920).—Instead of using the usual track to support the core trucks, "I" beams and trolleys were used to support them from overhead. This arrangement removed the supporting elements from the zone of most intense heat. The ends of the trucks were made as oven doors so that when one truck was drawn out for reloading, the back end of the truck acted as a door and closed the oven, permitting access to one truck while the cores on the other truck were baking. A. W. OWENS. (*C. A.*)

26. Steel, sand properties. R. L. LINDSTROM. *Foundry*, **48**, 940–3 (1920).—Lab. tests should precede large purchases of sand or clay for steel foundry purposes. Both sand and clay should be of the same high quality. The ideal *clay* will have both high bonding power and a high softening point. For the bonding tests 10% clay is mixed with 90% of a good sand and with enough water so that the mixt. will just adhere to the palm of the hand. Knead for exactly 2 min. and age in a covered receptacle for 12 hrs. A block 1 by 1 by 12 in. is made under uniform pressure and is pushed lengthwise over the edge of a glass plate until it breaks off. Considering 3 in. as 100, the length breaking off is the bonding strength. The following specifications will designate a good clay: bonding strength 85, softening point 1600°, fineness test, not more than 5% shall remain on a 20-mesh sieve and not less than 75% on a 100-mesh. A good sand will be high in silica (97–99%); 85% should be retained on the 20-,40-,and 60-mesh screens and the grains should be well rounded. A. W. OWENS. (*C. A.*)

27. Converting high-grade mat in magnesite-lined converters. H. C. ROBSON. *Bull. Inst. Mining Met.*, **1920**, No. 194, 10 pp. (*C. A.*)

28. Méker burners and Méker furnaces (gas) for industrial purposes. STAVORINUS. *Het Gas*, **40**, 214–8 (1920).—A discussion of the use in the industries, chiefly metallurgical, of Méker burners and furnaces.
NATHAN VAN PATTEN. (*C. A.*)

29. Heating-furnace fuel progress during 1920. A. E. BLAKE. *Blast Furnace & Steel Plant*, **9**, 179–80, 18 (1921). E. J. C. (*C. A.*)

30. Foreign graphite in 1919. ARTHUR H. REDFIELD. U. S. Geol. Survey, *Mineral Resources of U. S.*, **1919**, Part II, 181–210 (preprint No. 12, published Feb. 5, 1921). E. H. (*C. A.*)

31. Fuel saving by furnace efficiency. SYDNEY N. DUGUID. *Chem. Age* (London), **3**, 592–3 (1920).—See *C. A.*, **14**, 3778. (*C. A.*)

32. Glory holes and magnesite. R. A. BANKSON. *Eng. Min. Jour.*, **111**, 49–52 (1921).—Prior to the war our supply of mag. was obtained from Austria. At the outbreak of the war this supply was cut off and a scramble took place to find domestic mag. The two principal sources found were in Calif. and in Wash., but since the Calif. material is amorphous, only the Wash. deposits furnished material suitable for refractories. As the price rose two important concerns and numerous smaller operators started to mine and burn mag. From a max. of $160 at the time the armistice was signed, the price dropped $80 in a day and thus forcing many of the smaller operators to drop out. Shortly after a third concern, the American Mineral Production Co., entered the field and is now in competition with the first two companies in the fields. The A. M. P. C. owns the Austrian deposits and so, due to the fact that it is trying to block the protective tariff, the rival companies claim

that it is trying to discredit the Amer. deposits. Since the demand is limited and cannot be increased it is a question as to whether Amer. deposits or Amer. owned foreign ones will supply the market. The older companies ask for a tariff of $15 a ton and even with that they claim that the Austrian mag. is cheaper, and that without it the Amer. mag. industry will be doomed and their equipment and property rendered worthless. The A. M. P. C. state that a protective tariff is unnecessary at the present time since the Austrian mag. costs them more to produce than the Amer. After two years, it is claimed, conditions will probably be such that the tariff question can be definitely decided. They also state that the tariff will affect them equally with the other companies since they intend to fully develop their Amer. supply. A possible outlet for the Amer. mag. is through the manufacture of plastic magnesite. One of the older companies has just completed a furnace for the production of this material.

33. Magnesite. R. W. STONE. *Eng. Min. Jour.*, **111,** 158 (1921).—A short résumé of the magnesite industry in 1920.

34. Graphite industry. B. J. MILLER. *Eng. Min. Jour.*, **111,** 157 (1921). A short résumé of the graphite industry in 1920.

35. Bauxite and aluminum. J. M. HILL. *Eng. Min. Jour.*, **111,** 155–156 (1921).—A short résumé of the bauxite industry in 1920.

36. Zirconium. Uncommon ores and metals. H. C. MEYER. *Eng. Min. Jour.*, **111,** 150–1 (1921).—A short résumé of the zirconium industry in 1920.

37. Chromite. S. H. DOLBEAR. *Eng. Min. Jour.*, **111,** 147.—A short résumé of the chromite industry in 1920.

38. The uses of graphite. CONSULTATION. *Eng. Min. Jour.*, **111,** 430 (1921).—A short discussion of the uses of graphite. D. D. SMYTHE.

39. Why Washington magnesite mines shut down. R. W. STONE. *Eng. Min. Jour.*, **111,** 464 (1921).—The three companies producing magnesite in Stevens Co., Wash., have suspended operations almost completely. It is claimed that the shut-down is due to the importation of Austrian magnesite but statistics show that the imports form only 18% of the magnesite consumed in 1920. The more probable reason is lack of orders from the steel companies as many steel plants are now idle.

40. Graphite production in Madagascar at a standstill. ANON. *Eng. Min. Jour.*, **111,** 378 (1921).—In the Commerce Reports of the French Ministry of the Colonies it is stated that due to present business conditions the operation of a number of old deposits has ceased and no new ones have been opened in the graphite districts of Madagascar.

41. Chromite deposits of Bahia, Brazil. H. E. WILLIAMS. *Eng. Min. Jour.*, **111,** 376–8 (1921).—Some years before the war chromite was discovered

at Santa Luzia, 303 km. by rail from the city of Bahia. A large amount of ore was extracted during the war but since then the mines have been idle. The country rock consists of a fine-grained quartzose gneiss cut by dikes of pegmatite. The chromite occurs as lenses in the gneiss. D. D. SMYTHE.

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42. Alumina. S. E. SIEBURIN. Brit., 153,500, Jan. 19, 1920. Al_2O_3 is prepd. from a HCl soln. of any aluminous material by calcining the crystals of $AlCl_3$ obtained by satg. the soln. with the gaseous HCl resulting from a previous calcination. The $AlCl_3$ is calcined in a continuously working furnace, consisting of several stories, each of which is provided with an outlet, and the gases evolved from a particular batch are not conveyed to the $AlCl_3$ soln. until they contain sufficient HCl. When an ordinary type of furnace is used, the issuing gases are passed through a condenser, in the first chambers of which a watery soln. of HCl is formed while acid substantially free from H_2O remains uncondensed and is conveyed to the saturator. (*C. A.*)

43. Zirconium salts. H. WADE. Brit., 153,113, Aug. 8, 1919. A new basic sulfate of Zr of the compn. $5ZrO_2.3SO_3.13H_2O$ free from Fe, Ti, and Si is obtained by adding H_2SO_4 in the requisite quantity to a soln. of Zr oxychloride containing free acid, preferably HCl. The basic sulfate is pptd. on heating. (*C. A.*)

44. Aluminothermic production of zinc and corundum. KOHLE und ERZ G. m. b. H. Ger., 319,814, May 8, 1917.—An intimate mixt. of Al, ZnO of a high degree of purity, and Zn dust is subjected to the aluminothermic process. The Zn dust is added in such amt. that the speed of the reaction is regulated, and the excess heat of the reaction is utilized. The Zn vapor may be condensed, and the Al_2O_3 obtained as a high-grade *corundum*. The excess heat is used to melt down the otherwise difficultly melted Zn dust. (*C. A.*)

Chemistry, Physics and Geology of Raw Materials

45. Determination of ferrous and ferric oxide in acid open hearth slag. GEORGE T. DOUGHERTY. *The Chemist-Analyst*, **32**, 18 (1921).—Place in a 60 cc. lead test tube $^1/_2$ gr. finely ground slag and 5 cc. water. Heat gently in current of CO_2 until oxygen is removed. Then remove stopper, add 5 cc. HF and 10 cc. 1-1 H_2SO_4, replace stopper and start current of CO_2 gas and continue heating gently for 30 minutes. Remove test tube from source of heat, add 25 cc. cold H_2O, stopper and immerse tube in cold water. Transfer contents of tube to casserole containing 250 cc. water, 15 cc. 1:2 H_2SO_4 and 5 g. boric acid. Stir and titrate with standard $KMnO_4$. Compute FeO. Decompose a second sample of material in platinum in the same way and reduce with stick of zinc. Add 4 g. boric acid and titrate with $KMnO_4$. Compute total Fe and then Fe_2O_3 by diff.

46. Decomposition and analysis of silicates without the necessity of fusion. HERBERT E. ZSCHIEGNER. *The Chemist Analyst*, **32**, 21 (1921).—This method

was successfully used in the analyses of fused magnesia and should be applicable to many compounds of Mg, Ca, Si, Fe and Al. Digest 1 g. of finely powd. sample with 1-1 HCl, dilute with equal vol. hot water, filter and wash residue three times with hot water. Evap. filtrate to dryness twice with HCl. Warm residue with 5 cc. water and 2 g. KOH. The silicates decompose forming soluble K_2SiO_3, at the same time liberating any mechanically enclosed Fe, Mg, and Ca oxides. Acidify the KOH solution with HCl and evap. to dryness twice. Combine with residue from filtrate, dissolve in hot water and HCl and filter through same filter. The remainder of the analysis proceeds by customary methods.

47. Acidity of Japanese acid clay. KIUHEI KOBAYASHI. *J. Chem. Ind.* (Japan), **23,** 543–9 (1920).—Japanese acid clay (Japanese fuller's earth) has the compn. $Al_2O_3.6SiO_2.H_2O$, and is probably a mixt. of colloidal hydrous Al silicate ($Al_2O_32SiO.H_2O$) and an amorphous compound of ortho-silicic acid ($SiO_2.H_2O$) containing certain basic compds. as impurity. The reason why this clay should give an acid reaction was investigated by K., who found *no true acid substance in the clay* itself. The conclusion is that the acid reaction on blue litmus paper or other indicators is due to free mineral acid liberated by adsorptive action of this clay. When it is added to some basic dye (R-Cl), then there may be supposed the existence of a so-called Helmholtz's double layer on the surface of the clay and that the clay adsorbs OH^- according to its property as an acid gel, H^+ being thus liberated. R. combines with OH^- and H^+ unites with Cl^- of the dye. In a similar manner, when the acid clay is added to neutral KCl soln., it adsorbs K^+, and HCl will be formed, which in turn dissolves Al of the clay. Subsequently $AlCl_3$ is hydrolyzed to $Al(OH)_3$ and HCl. K. observed that silk or wood fibers also change blue litmus paper to red, and concludes that these fibers must act in a similar manner as the clay.

S. T. (*C. A.*)

48. A rapid method for the estimation of MgO in portland cements. MAX ALBERT. *The Chemist-Analyst,* **32,** 7 (1921).—The following modification of the standard method is simple, rapid and sufficiently accurate for cement mill and commercial laboratories. The saving in time is effected in two stages of the analysis: 1. By weighing out the samples directly into 400 cc. Pyrex beakers, instead of casseroles, and filtering off the silica together with the iron and alumina. The phys. and chem. properties of Pyrex glassware are such, that they safely permit the baking of the dry residue from the evap. of the initial HCl solution of cement. Also, a separate filtration of the silica is avoided. 2. By volumetric determination after precipitation of magnesium ammonium phosphate. For this purpose the magnesium ammonium phosphate precipitate after filtering and washing (three times with 5% ammonia and twice with 95% alc.) is transferred to a 100 cc. beaker and allowed to dry. Then add 10 cc. stand. 0.1 *N* H_2SO_4 and three drops of methyl orange. When solution is complete add 15 cc. hot water and titrate excess H_2SO_4 with standard 0.05 Na_2CO_3. Compute MgO. By means of this method 6 determina-

tions can be made in $5^1/_2$ hours as against 9 hours required by the stand. method. Check determinations indicate a max. error of 0.05% in MgO. Method is also applicable to *clays* and *limestone*. (*C. A.*)

49. The physics and chemistry of colloids and their bearing on industrial questions. Some observations on peptization and precipitation. N. G. CHATTERJI AND N. R. DHAR. *Chem. News*, **121**, 253–6 (1920).—AgCl, Ag_2CrO_4, and calcium silicate are not peptized in the presence of concd. soln. of cane sugar (contrary to Bancroft—2nd Annual of Brit. Assn. on Colloid Chem.). Hydroxides of Fe, Ni, Th, Hg, Co, etc., were peptized by adding NaOH to solns. of the respective salts in presence of glycerol or sugar (in the case of V and Au, NH_4OH should replace NaOH). But glycerol and sugar will not peptize the hydroxides if added subsequent to pptn. It is a curious fact that prompt pptn. occurs if the salt soln. be added to a mixture of glycerol and the alkali hydroxide. No peptization seems to occur with $Sb(OH)_3$, CuF_2, or $BaSO_4$. The cond. of a soln. of NaOH is not appreciably changed by the addition of the hydroxides of Cr, Al, Pb, Hg, but in the case of Zn the resistance increased appreciably. "Hence we can conclude that the solns. of $Al(OH)_3$, $Cr(OH)_2$, $Pb(OH)_2$, $Hg(OH)_2$, and $Cu(OH)_2$ are cases of true peptization and not of chem. combination. On the other hand, in the case of $Zn(OH)_2$, we get more of the chem. combination than of peptization." Confirming the work of Bentley and Rose (*C. A.*, **7**, 3882) freshly pptd. $Al(OH)_3$ is peptized by acetic acid; so also are $Fe(OH)_3$ and $Cr(OH)_2$. But with $Zn(OH)_2$ the cond. rises greatly, indicating that this more strongly basic hydroxide has mainly formed Zn acetate. Blue $Cu(OH)_2$ containing a trace of undecomposed Cu salt is stabilized by it, and does not turn black on boiling as would otherwise be the case. The protective adsorbed Cu salt may be washed out by *hot* water, and the black $Cu(OH)_2$ may be rendered blue on boiling with a trace of Cu salt. In general the stronger the kind of alkali, the more rapid was the change from blue to black—KOH > NaOH > $Ba(OH)_2$, etc. The color change of $Co(OH)_2$ from blue to pink is analogous to that of $Cu(OH)_2$ and is similarly effected by catalysts. "All those salts which produce a hydroxide sol. in excess of NaOH, namely, salts of Zn, Al, Sn, Pb, etc., markedly retard the transformation of both the blue $Cu(OH)_2$ to the black form, as well as that of the blue variety of $Co(OH)_2$ to the pink form. It seems probable that the presence of $Al(OH)_3$, $Pb(OH)_2$, $Sn(OH)_2$, etc., in the colloidal state tends to peptize the $Co(OH)_2$ or the $Cu(OH)_2$." $Fe(OH)_2$ when pptd. in solns. of the hydroxides of Al, Cr and Zn in NaOH, adsorbs and carries down some of the latter hydroxides. JEROME ALEXANDER. (*C. A.*)

50. A graphical method for the interpretation of flue gas analysis. GILBERT B. HOWARTH. Univ. Leeds. *J. Soc. Chem. Ind.*, **39**, 329–33T (1920).—Lengthy calcns. are generalized by coördinate charts to show (1) the ratio of the amt. of air supplied for combustion to the minimum theoretical amt. for complete combustion; and (2) the ratio of the amt. of heat in the hot flue gases to that liberated by combustion of the fuel. Four variables are involved, of which it is necessary to know two: (1) The % extra air based on the

minimum required for combustion; (2) the % O in the dry flue gases; (3) the % CO_2 in the same; (4) a const. depending on the compn. of the fuel. These 4 variables are plotted so that if the values of any 2 are known, the others are detd. The method is most useful when the constant (fuel factor) is known, so that detn. of the % CO_2 alone in the dry flue gases gives the % O and the extra air. These graphs are applicable to nearly all fuels. The value of the fuel factor from lignite to anthracite varies from 0.63 to 0.40, representing a difference of 0.5% in CO_2. The detn. of any physical property of the flue gases may be made by superimposing curves on the extra-air diagram. In this way measurements can be made on flue gases satd. with H_2O at any temp. by a series of curves. Also in *Blast Furnace & Steel Plant*, **9**, 175–8 (1921). C. C. DAVIS. (*C. A.*)

51. Heat of sublimation of carbon. H. KOHN. Univ. Breslau. *Z. Physik*, **3**, 143–56 (1920).—K. shows that Fajan's calcn. of the heat of sublimation, λ, of C (*C. A.*, **14**, 1623) from the pressure-intensity relation of the C arc can be improved in the matter of temp. measurement. With the temp. correction the value of λ for C is 163.5 kg.cal. (168 for diamond).
F. C. HOYT. (*C. A.*)

52. Identification of quartz particles in konimeter samples. A. W. ROGERS. *J. Chem. Met. Soc. S. Africa*, **21**, 11 (1920); cf. *C. A.*, **14**, 2455.—Further expts. showed that while *o*-toluidine of n 1.57 worked well on dry quartz and mica dust, it was a failure on konimeter samples, as it did not dissolve the vaseline sufficiently. Dimethylaniline dissolved the vaseline, but rendered the quartz particles almost invisible, the dissolved vaseline lowering the n to the same av. as that of quartz. $CHBr_3$ and C_6H_5Br were tried. The liquid finally recommended was a mixt. of 5 pts. C_6H_5Br and 1 pt. α-bromonaphthalene, which is permanent, gives no crystals on keeping, practically nonvolatile and dissolves vaseline. Four parts of this mixt. plus 1 of vaseline of n 1.492 gave a mixt. having the required n, 1.57. L. W. RIGGS. (*C. A.*)

53. Adsorption by silica gel. E. B. MILLER. *Chem,. Met. Eng.* **23**, 1155–60, 1219–22, 1251–4 (1920).—In this series of papers are considered the basic facts and observations on adsorption of vapors by silica gel. G. L. C. (*C. A.*)

54. The viscosity-concentration function of polydispersed systems. H. LÜERS AND M. SCHNEIDER. Munich. *Kolloid-Z.*, **27**, 273–7 (1920).—The relation of viscosity to the concn. of polydispersed systems of flour and water (rye, wheat, malt and barley flour) is expressed by $\eta_s = \eta_0(1 + kf + k_1 f^n)$ in which η_s = the viscosity of the suspension, η_0 = that of water (1), f = the ratio of the vol. of the dispersed phase to the total volume, k, k_1 and n are consts. This is similar to the equation of Ostwald and Mundler for the osmotic pressure of dispersoids (*C. A.*, **13**, 1412). The theoretical equation of Hess (*C. A.*, **14**, 3176) $\eta_s = \eta/(1 - \alpha k)$ in which k is the vol. of the dispersed phase in unit vol. of the system and α a function of the vol. due to the "dead space" about each particle, fits the observed viscosities about equally well.
H. I. MATTILL. (*C. A.*)

55. Colloid development. HARRY N. HOLMES. *J. Ind. Eng. Chem.*, **13**, 357 (1921).—Contains selected bibliography of 25 titles.

56. Humidity control by means of sulphuric acid solutions, with critical compilation of vapor pressure data. ROBT. E. WILSON. Mass. Inst. Tech. *J. Ind. Eng. Chem.*, **13**, 326 (1921).

57. The structure of precipitates. SVEN ODIN. *Svensk Kem. Tidskrift*, **32**, 74–85, 90–98, 108–110 (1920).—An important contribution to the laws governing the nature of the particles obtained by the settling of suspended material such as kaolin. The character of the prec. and the influence of electrolytes are discussed in detail. For extended abstract see *C. A.*, **15**, 971 (1921). Esc.

58. The angle of slope (Böschungswinkel)—a new physical constant. A. LANGHANS. *Kolloid-Z.*, **27**, 101–23 (1920).—This const. is defined as the angle (β) which the sloping side of a pile of discrete material forms with the horizontal. The original must be consulted for complete data on the 90 different salts, metallic powders, and org. compds. studied by L. Extensive tables give the value of β detd. by 3 methods in each case together with measurements of the av. size of the particles and their sp. wt. Values found in the literature for *sand, clay, gravel*, etc., are also tabulated, and the importance of this const. in relation to the handling of such substances is emphasized. App. and methods for the accurate detn. of β are given. L. discusses the theory involved, and the relationship of β to the sp. wt., size, and coeff. of friction of the particles. H. W. BANKS, 3RD. (*C. A.*)

59. Mica in Australia. B. DUNSTAN. *Min. Mag.*, **24**, 120.—In the *Queensland Gov. Mining J.*, for Oct., 1920, D. gives an account of the mica production of the world. There are a number of mines in Australia, none of which are being worked at the present time. Probably the most important of these is the Rifle Creek area near Cloncurry, Queensland. Here there are a number of mica-bearing pegmatite dikes. One dike examined was 10 to 12 ft. wide and made up almost entirely of crystals of mica. The weathered material (which is all that has been sampled as yet) has tested quite satisfactorily in spite of its condition. Another important deposit of similar nature is at Hart's Range near the Arltunga goldfield in the Northern Territory. From present imperfect knowledge the fields appear to be quite promising but development is held back by the lack of transportation and other facilities.

60. Bauxite-aluminum ores in West Australia. ANON. *Min. Mag.*, **23**, 352–3 (1920).—The purpose of the article is to furnish a brief description of W. Australian bauxite deposits for the use of investigators. It consists of a description of the lateritic bauxite deposit of the Darling Range together with suggestions for the examination and the estimation of the aluminum content in the field.

61. Mineral production of Canada for 1919. Canada Dept. of Mines, Mines Branch. Gives statistical data on the Canadian production of *Abrasive*

Materials, Barite, Feldspar, Quartz, Talc, Cement, Clays, Graphite, Magnesite, and *Mica.*

62. Clay. Report of the Colorado Coal Fields of Texas. N. F. DRAKE. University of Texas, *Bull.* **1755,** 69–70, Oct., 1917.—The clays of this district fall into two classes, (1) those which occur in the regular beds interstratified with other rocks and (2), alluvial material derived by erosion from clays of the first type, and deposited in the valleys. The alluvial type contains considerable sand and is used for common brick. Sample analyses show that iron and other fluxing elements are high in all the clays. D. D. SMYTHE.

63. The talc industry in 1920. RAYMOND B. LADOO. Bur. Mines, *Repts. of Investigations,* No. **2204,** 5 pp. (1921). E. H. (*C. A.*)

64. Asbestos. OLIVER BOWLES. *Eng. Mining J.,* **111,** 155 (1921). **Barytes.** J. B. PIERCE, JR. *Ibid.,* 155. **Fuller's earth in Georgia.** S. W. MCCALLIE. *Ibid.,* 156–7. **Graphite industry.** BEN. L. MILLER. *Ibid.,* 157. **Gypsum.** FRANK A. WILDER. *Ibid.,* 157. **Magnesite.** R. W. STONE. *Ibid.,* 158. **The mica industry.** J. VOLNEY LEWIS. *Ibid.,* 158. **Monazite.** H. C. MEYER. *Ibid.,* 158. **Potash.** F. W. BROWN. *Ibid.,* 159. **Strontium.** J. B. PIERCE, JR. *Ibid.,* 160. **Talc and soapstone.** RAYMOND B. LADOO. *Ibid.,* **161.**—Reviews from the point of view of mining and industry. E. J. C. (*C. A.*)

65. Cristobalite in the spherulitic obsidian from Yellowstone National Park. AUSTIN F. ROGERS. Stanford Univ. *Am. Mineral.,* **6,** 4–6 (1921).—The n of the obsidian is 1.480, which proves that it is rhyolitic, and high in SiO_2. In the lithophysae are rods of orthoclase, with $n = 1.523$, and cristobalite, in minute spherical aggregates. It is readily identified by its n, 1.485, and by its behavior on heating and then cooling, when it becomes opaque suddenly at a transition point around 200°. E. T. W. (*C. A.*)

66. Economic minerals of Madagascar. GEORGE F. KUNZ. *Eng. Mining J.,* **111,** 14–6 (1921).—An article compiled from an address by A. Larcoix at the French Natl. Museum of Nat. History, Paris, May 2, 1920, and an article by Duparc on minerals of the pegmatites, published in Geneva in 1910. Notes are given on *graphite, corundum* and *rare earths.* E. V. SHANNON. (*C. A.*)

67. Can Swedish quartz be substituted by German sandstone? P. BARTEL. *Keram. Rundschau,* **28,** 449–50, 459–60 (1920).—Müller (*Keram. Rundschau,* **1903,** 652) found that it was possible to produce fine translucent porcelain by using pure sand. He further states that the sand should not be used in the moist condition but should be calcined before using. Grimm (*Sprechsaal,* **1905,** 925) found that if sand was calcined and ground to the same degree of fineness as quartz it produced products equally as good as those obtained by using quartz. Calcined quartz can be ground to the proper degree of fineness in 18–24 hrs. and calcined sand in 20–28 hrs. Pure sand is used for making high grade glass and glazes. Reike and Endell (*Silikat-Zeit.,* **1913,** 48) found

that bodies containing sand were grayer than those containing quartz even when the sand was purer than the quartz. This is attributed to a difference in the structure of the sand and quartz grains in bodies. The sand grains do not become cracked or shattered upon heating as the quartz grains do and hence sand grains do not reflect the light from as many surfaces. Quartz is used by B. for making the finer porcelains, but sand is used for making the coarser ware. In attempting to use sand for the finer ware it was found that it produced a body which was not as translucent as quartz bodies and it was open, due to the coarser grains of sand. H. G. SCHURECHT.

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68. Ultramarine. J. B. GIUMET and A. GUILLOCHIN. Brit., 152,916, Feb. 14, 1920.—Sulfites or bisulfites of the alkalies, or mixts. of these salts are used in the manuf. of blue and green ultramarines to replace wholly or partially the alkali carbonates or sulfates usually employed. The Na_2SO_3 obtained as a by-product in the prepn. of phenol is particularly suitable for this purpose. In an example, the furnace charge consists of *kaolin*, Na_2SO_3, S, and a reducing agent such as resin. (*C. A.*)

Abrasives

69. Abrasives. J. V. LEWIS. *Eng. Min. Jour.*, **111,** 154.—A short résumé of the abrasive industry, mainly emery and corundum, in 1920. D. D. SMYTHE.

70. Abrasives and grinding wheels bonded with ceramic materials. KARL HECHT. *Keram. Rundschau*, **28,** 511–12, 521 (1920).—Abrasives arranged in order of their hardness are as follows: (1) carborundum with 70% SiO_2 and 30% C (2) artificial corundum with 96% Al_2O_3, (3) emery with 60–70% Al_2O_3, and (4) emery with 48–69% Al_2O_3. Carborundum is best suited for metals which are easily torn (as brass), and corundum is best suited for cast steel, cast iron and hard and soft steel. A mixt. of clay and a feldspar frit is used as a bond. The bond should be soft for grinding hard steel but should be hard for grinding cast iron since it is desirable to have the abrasive particles remain intact until they are worn smooth. According to a patented process the Schliefmachinen and Scliefrader-Werk, Friedrich Schmaltz, G. m. b. H., separate the abrasive material from old grinding wheels by grinding, heating under pressure with an alkaline solution which causes the bond to swell, and finally removing the bond by treatment with dilute acids. H. G. S.

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71. Abrasive compositions. F. P. JONES and A. FLEMING. Brit., 153,692, Aug. 18, 1919.—A substitute for pumice blocks, etc., for abrasive purposes consists of SiO_2, sand, firestone, glass, china or the like 76 parts by wt., MgO 7, $MgCl_2$ 7, wax, sawdust, S, or NH_4Cl 10, and H_2O 10 parts. The compn. is molded, and after setting is heated to melt the wax, S, etc., or to char the sawdust. According to the provisional specification, pores may also be pro-

duced by the addition of a sol. salt, which is washed out after the compn. has set. The compn. in that case may be SiO_2, sand, etc., 75 parts by wt., port. cement 15 parts, NaCl 10–20 parts and sufficient H_2O to bind. (*C. A.*)

See also Abst., No. 44.

White Ware and Porcelain

72. A colorimeter operating on the subtractive principle. L. A. JONES. *J. Optical Soc. Am.*, **4**, 420–30(1920).—For field and com. use, a colorimeter utilizing the subtractive principle of color mixt. seems to combine best the features of portability, simplicity of operation and freedom from the necessity of delicate adjustment of parts. An image of the object whose color is to be measured is brought by a lens system so that it occupies one-half of the field of the colorimeter tube. A neutral gray filter can be used if necessary to control the intensity of the light from the object so that it shall fall within the range of the instrument. The standard of comparison is an incandescent bulb which, with the proper current supplied through a control box and a suitable filter, gives a light matching noon sunlight; this is checked occasionally against a standard light. Four gelatin wedges are so placed that they may be inserted to any extent or withdrawn completely from the path of the beam of light from this source to the fields of the instrument. Three of the wedges are of the subtractive complementary colors: minus green (transmitting red and blue), minus blue (transmitting red and green), and minus red (transmitting green and blue); the fourth wedge is neutral gray to control the light intensity. By proper adjustment of these wedges any color can be matched; the position of each wedge is indicated by a pointer and can be read on a graduated scale. While the instrument was designed primarily for the measurement of the color of objects at some distance, it can be easily adapted to examine transparent colored solids, liquids, or reflecting surfaces.

D. W. M. (*C. A.*)

73. The manufacture of pressed porcelain. ERICH RUTH. *Keram. Rundschau*, **29**, 33–9 (1921).—Porcelain electric insulators are either turned or pressed. The high tens. insulators are usually turned. For pressed insulators cheaper materials may be used. The bodies after being dried are mixed with *pressing oil* and water and after storing are pressed. Many pieces may be made by automatic machinery.

74. The mechanical properties of porcelain. E. ROSENTHAL. *Keram. Rundschau*, **29**, 81–2, 93–4 (1921).—The strength of porcelains may be divided into two classes (1) resist. to static pressure, *i. e.*, when the load is applied slowly and (2) resist. to impact, *i. e.*, when the pressure is applied suddenly. The compression and tens. strengths are determined in the customary manner. The torsion strength which heretofore has never been determined is about 430 kgs./cm.^{2} while that of cast iron is 2228 kgs./cm.^{2}, and for cement is 35.7 kg./cm.^{2} The vol. of transmission or vibration of sound varies with the mod. of elast. Those having the highest velocity are the best porcelains.

This vel. may be increased by increasing the clay content. Also pure light burning clays give better results than impure clays. The impact tests are made by the Marten method by letting a pendulum drop on to the test piece from different heights until breakage occurs. The results of this test checked closely for different sizes of test pieces. The following results were obtained on a number of porcelains:

	A	B	C	D	E	F	G	H
1—Insulator body G	4000–	...	481	590	0.90	98	...	2.4
2—Insulator body H	5000	261	500	540	0.95	105	5630	3.3
3—Table ware	...	...	...	640	1.36	112	...	...
4—Chemical porcelain	...	...	500	410	1.23	117	5930	...
5—Hermsdorfer hard porcelain	4780	...	...	490	...	...	5050	...
6—Hard porcelain No. 6292 (Amer.)	...	...	...	520	0.08	...	...	...
7—Seger porcelain, No. 6833	...	...	430	...	1.00	69	5340	...
8—Special body No. 6412	...	...	...	980	2.40	146	...	1.7
9—Special body No. 6048	...	...	...	...	1.61		6680	...
10—Glasspot body	...	...	...	...	0.34	8	...	...
11—Refract. body	...	...	...	...	0.33	7	...	...

A = Compress. strength kg./cm.^{2} (B) Tens. strength kgs./cm.^{2} (C) Torsion strength, kg./cm.^{2}. (D) Cross-breaking strength, kg./cm.^{2} (E) Impact cross-breaking strength, cm., kg./cm.^{2}. (F) Impact compress. strength, cm., kg./cm.^{2} (G) Vel. of transmission, m./sec., and (H) Loss in volume from sand blasting. *One test is not sufficient to measure the strength of porcelains.* Many porcelains which stand up well in one test fail in another. This is true of the Amer. porcelain 6292 which stands up well in cross-breaking strength but fails in the impact test. Bodies G and H also stand up well in cross-breaking strength but fail to show a high resist. to impact.

H. G. SCHURECHT.

75. Tennessee ball clay and its manufacturing possibilities. W. A. NELSON. *Mfgr's. Record*, Baltimore, Md., Feb. 17, **1921,** 6 pp.—Although Tenn. produces ball clay equal to the famous Eng. ball clays, and lies in a region of cheap fuel the South is still supplied with tableware made in northern plants from Tenn. clays. Other raw materials can be obtained from neighboring states at rates equal to or less than those which the northern concerns must pay, while the labor cost, the most important single factor in the cost of pottery production, is fixed regardless of location. It would appear therefore that southwestern Tennessee would be an excellent location for plants which would supply the south with tableware, since freight rates, a very considerable item on chinaware, would be most advantageous from this location. The most important clay deposits, all of which occur in Henry and Carroll Counties, are described in this article. A list of the leading clay producers of Tennessee is given together with maps showing the location of their pits. The uses of ball clay are mentioned and a few figures given regarding the production and prices.

D. D. SMYTHE.

Glass

76. A new method of joining glass. C. O. FAIRCHILD. *J. Optical Soc. Am.*, **4**, 496–503 (1920); cf. Parker & Dalladay. *Trans. Faraday Soc.*, **12**, 305.—This method is particularly applicable for joining lenses, making colorimeter tubes, plane glass incandescent bulbs, etc. The object is heated in a small electric furnace to approx. its annealing temp., sufficiently high to avoid cracking while applying heat locally, and the junction of the two parts is rapidly passed over with a small oxy-gas blowpipe flame. By this method complete fusion of the junction can be accomplished without propagating beyond a restricted portion near the joint the stresses occasioned by local heating; hence it is applicable where a slight deformation at the junction does not impair the usefulness of the object. The furnace can be quickly heated so that a small glass article can be raised to temps. above the annealing temp., the junction completed by application of the flame, and cooling initiated before the glass has had sufficient time to appreciably change its shape. The two parts need not be of the same glass, nor need there be a perfect fit; the method fails only for glasses which have too widely differing coefficients of thermal expansion. DONALD W. MACARDLE. (*C. A.*)

77. Shock-defying glass. ANON. *Mining and Metallurgy*, No. **169**, 50 pp. (1921).—Laminated glass is made in various thicknesses to withstand almost any impact to which glass might be subjected. Glass for bank tellers, cages is made of three thicknesses of glass. The middle section is plate glass nearly $^{9}/_{16}$ in. thick; the two outer parts are $^{1}/_{8}$ in. thick. Between the core and the outer sheets are imposed sheets of transparent pyroxylin 0.2 in. thick. A piece of glass of this compn., 6 in. square, was shot at from a distance of 3 ft., with a rifle using a 32-caliber, nickel-jacketed, flat nose, high-velocity rifle bullet. The bullet powdered the glass at the point of impact over an area $1^{1}/_{2}$ in. in diam. The bullet, however, penetrated only the top layer of the glass and the sheeting was exposed only in one spot about $^{3}/_{8}$ in. in. diam., but it was not even dented by the bullet. The heavy plate-glass core was broken as was the under-sheet of glass, but was not penetrated and the only glass that fell from the underside of the block were some pieces so small that they could have caused no injury had they fallen on a person even from a great height. Glass for windows liable to be subjected to shock from explosions need only be the thickness of two ordinary sheets of window glass with one sheet of pyroxylin sheeting between them. The lamination is effected by hydraulic pressure. If an explosion causes the glass to crack, it is prevented from falling by the pyroxylin core. CHARLES E. MUNROE. (*C. A.*)

78. British chemical glass industry. S. N. JENKINSON. *Chem. Age* (London), **3**, 619 (1920).—The leading British chem. glasses are compared with Jena glass, for resistance to action of boiling HCl and HCl vapor. For figures see *C. A.*, **12**, 212. (*C. A.*)

79. Normal or standardized fittings. ALFRED STOCK. *Z. angew. Chem.*, **33**, I, 280 (1920).—Could one replace the varied cuts or tapers on stopcocks,

necks of vessels, etc., with normal or standard forms, making the parts interchangeable, it would mark an extraordinary advance in app. manuf. To be entirely successful such parts must be made so as to require no final grinding or fitting by the purchaser and user. Adapters and connections for extn. flasks and other app. are better when made of the insert, rather than the slip-over or cap type. W. C. EBAUGH. (*C. A.*)

80. Two laboratory applications of the triode valve. J. SCOTT TAGGART. *Electrician*, **86**, 124 (1921).—The app. described distinguishes between infinite resistance and one of very high value. It was used to determine the temp. at which *glass* begins to conduct electricity. ED.

81. The effect of temperature upon the infra-red absorption of certain glasses. G. E. GRANTHAM. *Phys. Rev.*, **16**, 565–74 (1920).—An investigation to study the effect of temp. upon the infra-red absorption spectra of the same specimens used by Gibson (*C. A.*, **10**, 1001) and to see whether the shift of the edge of an absorption band was coincident with a shift of a transmission band lying largely in the infra-red or resulted in a narrowing of such a transmission band. In addition, measurements were made on a specimen of Corning G. 585 blue glass of 1.98 mm. thickness. The 5 specimens were in turn placed in a furnace and the absorption spectra studied between 0.6 and 4.0 μ for temps. of 80°, 307° and 440°. The core of the furnace was an Fe cylinder, 12 cm. long and 8 cm. diam., through the axis of which a hole 2.5 cm. in diam. was bored. The specimen was cemented to an Fe slide which fitted snugly into a slotted sleeve located at the middle point of the Fe core. The heating element was a coil of Fe wire wound around the cylinder over asbestos paper soaked in water-glass. The source of radiation was a 400-w. N-filled W lamp, which was placed against the end of the furnace and under conditions of thermal equil. gave a temp. of 80° at the specimen, with no current in the heating coil. A Hilger infra-red const. deviation spectrometer equipped with a Coblentz Bi-Ag thermopile was used. Temps. were measured by a Cu-constantan thermocouple, the junction of which was in contact with the specimen. A Coblentz astatic galvanometer was used, the sensibility obtained being about 3.3×10^{-11} amp. per mm. at 3 m. distance. For measurements between 2.0 and 4.0 μ, the correction due to the radiation from the furnace and specimen had to be detd. The red glass (Zn, colored with Cd-Se) showed a decrease in absorption with temp. rise over the whole range except for wave lengths less than 0.75 μ, when the absorption increases with temp. rise. There is evidence of a shift of the whole transmission band toward the less refrangible portion of the spectrum. For the orange-colored glass (non-Pb, colored with Cd-Se), there is indication of a slight shift with temp. rise of the transmission band extending over about the same region, 0.7 to 2.7 μ, as the transmission band of the red glass. There is a very slight increase in transmission throughout this band. At the 3.3 μ absorption band there is a marked increase in transmittance with temp. rise. The yellow-amber glass (borosilicate, colored with Cd-Se) showed a shift of the whole transmission

band toward the longer wave lengths with temp. rise and slight decrease in transmittance except in the region of absorption bands, when the transmittance increases. The lemon-yellow glass (Zn, colored with Cd-Se) shows at high temps. a decrease of transmittance throughout the range from about 0.6 to 2.4 μ. In the case of the blue glass, having sharp absorption bands, a temp. increase produces a decrease in absorption in the region of absorption bands in the infra-red. The peaks of the transmission bands are shifted toward the longer wave lengths at higher temps. This is caused by an increased absorption on the long wave length side of an absorption band and a decreased absorption on the short side. Consequently the absorption band is broadened without any apparent shift in the peak. This applies particularly well to the band having a max. between 1.3 and 1.8 μ. Ascending and descending temps. give the same results in all cases. In general, temp. rise decreases slightly the absorption in the region of an absorption band and causes a shift of the transmission bands toward the longer wave lengths, the shift being greater on the more refrangible edge. A. L. FEILD. (*C. A.*)

82. Electric heating in ceramics. WIRT S. SCOTT *Chem. Met. Eng.*, **24,** 400 (1921).—Many installations have been made for the treating of glassware. A 72-kw. furnace is used for annealing at 1200° F. This furnace is 22 in. wide, 10 ft. long and 5 ft. high and is of the overhead conveyor type. In one test several thousand goblets were annealed, the goblets being placed in metal containers consisting of nine trays each, each tray holding twenty-five goblets. Practically all the goblets proved to be A-1 grade after annealing. The natural-gas-fired furnaces in the same factory gave very few A-1 grade goblets, the majority being B-1 grade, with a quantity of C-1 grade. All glasses passed through the electric furnace were bright polish finish. In using an electric furnace for fusing bifocal lenses the loss was 3 to 4% compared to 20% with natural gas furnaces. Electric furnaces are being used successfully also for firing enameled steel articles. H. F. S.

83. Composition of glass for lamp chimneys. *Schnurpfeil's Review for Glass Works*, **4,** No. 48, 797 (1921).—Two batches gives (1) sand, 1000 lbs.; soda ash, 700 lbs.; limestone, 290 lbs.; antimony, 1 lb.; arsenic, 1 1/2 lbs.; nickel oxide, 1/2 oz. (2) Sand, 1000 lbs.; soda ash, 700 lbs.; limestone, 280 lbs.; lead, 20 lbs.; arsenic, 1 lb.; manganese, 1 1/4 lbs.; saltpetre, 2 lbs.; nickel oxide, 1/4 oz.

84. Composition of glass for pressed tumblers. *Schnurpfeil's Review for Glass Works*, **4,** No. 48, 797 (1921).—Sand, 100 lbs.; soda ash 34 lbs.; lime, 12; barytes, 10; saltpetre, 1 lb.; arsenic, 1/2 lb.; manganese, 5 oz.

85. Composition of glass for electric lamp bulbs. *Schurpfeil's Review for Glass Works*, **4,** No. 48, 797 (1921).—Sand, 100; soda ash 30; red lead, 35; lime, 5; saltpetre, 4; borax, 2; manganese, 1/4; arsenic, 1/4. R. J. M.

86. The phenomena of rupture and flow in solids. A. A. GRIFFITH. Roy. Aircraft Establishment. *Phil. Trans. Roy. Soc. Lon. A*, **221,** 163–98

(1920).—The theory of the subject is rather fully discussed and numerous expts. made with a hard Eng. *glass* of the following per cent comp. and properties: SiO_2 69.2; K_2O, 12.0; Na_2O, 0.9; Al_2O_3, 11.8; CaO, 4.5; MnO, 0.9; sp. gr., 2.40; Young's mod., 9.01 × 10 lbs. per sq. in. Poisson's ratio 0.251; tens. strength, 24,900 lbs. per sq. in. *Surface tension:* At 1100°C. the s. t. was meas. by Quincke's drop method (no details given). Between 900° and 730° C it was meas. by obs. the angle of sag, of a horizontal fibre weighted in the middle. Fibres 2 in. long and 0.002–0.01 in. diam. (*d*) were used the s. t. (T) being calc. from the relation $d.\ T.\ \sin\ ^1/_2 = w$, where w is the susp. wt. The following results were obtained showing that the s. t. of glass is approx. a linear function of the temp.

t°C	1110	905	896	852	823	820	801	760	744	15
T.10^3 lbs. per sq. in....	2.30	2.39	2.50	2.49	2.54	2.49	2.57	2.55	2.51	Extrap. 3.1

Below 730° the glass did not behave as a viscous liquid but rather as a plastic solid its yield value in lbs. per sq. in. being 0 at 730°, 1.3 at 657°, 24 at 540° and increasing very rapidly at lower temps. *Bursting strength of cracked bulbs and tubes:* "The breaking load of a thin glass plate having a sufficiently long straight crack normal to the appl. stress, is invers. prop. to the sq. rt. of length of the crack. *Strength of thin fibres:* To secure uniform results the glass must be heated to 1400–1500°C before drawing, the temp. during drawing should not fall below 730°, and the fibre should be allowed to age several days before testing. With this procedure the following results were obtained.

TENSILE STRENGTH OF GLASS FIBERS

Diameter 0.001 inch	Breaking Stress lbs. per sq. inch	Diameter 0.001 inch	Breaking Stress lbs. per sq. inch
40.00	24,900	0.95	117,000
4.20	42,300	0.75	134,000
2.78	50,800	0.70	164,000
2.25	64,100	0.60	185,000
2.00	79,600	0.56	154,000
1.85	88,500	0.50	195,000
1.75	82,600	0.38	232,000
1.40	85,200	0.26	332,000
1.32	99,500	0.165	498,000
1.15	88,700	0.130	491,000

The paper concludes with a discussion of the *mol. orientation theory*, the *practical limitations of the theory of elasticity*, methods of *increasing the strength of materials*, and applications to the theory of liquids. ED.

87. Some common defects occurring in glass. J. B. KRAK. *Glass Ind.*, **2**, 1–3 (1921).—*Causes and prevention or elimination of seeds and stones.* Seed may be caused by too much CO_2 or CO in the flame above the glass, and also by too high a temp. or too much alkali; it may be avoided by regulation

of the stack draft, by temp. control and by proper compounding of the batch. Sometimes the evolution of gas from an onion or potato is effective, or arsenic may be used. Batch stones, pot stones and cap stones are briefly discussed.

88. Progress made in plate glass manufacture. J. W. CRUIKSHANK. *Glass Ind.*, **2,** 3–6 (1921).—The method of teeming plate glass twenty years ago is described and compared with the present day mechanical method in which machines have largely taken the place of men. While there have been no fundamental changes of process, great progress has been made toward perfecting the art.

89. Manufacture of mother-of-pearl glass. O. SCHWARZBACH. *Sprechsaal*, **53,** 251 (1920).—Translation by H. W. Craver in *Glass Ind.*, **2,** 7–8 (1921). Cf. *Cer. Abstracts*, **3,** 928.

90. Glass industry in England and the United States. W. E. S. TURNER. *Glass Ind.*, **2,** 10–11 (1921); also *Pottery and Glass Record*, Dec. 15, 1920; cf. *Cer. Abs.*, **3,** 421.

91. Cutting bottle molds automatically. *Glass Ind.*, **2,** 23 (1921).—Description with illustrations of machine developed by the Keller Mechanical Engraving Co., for cutting two duplicates of any bottle mold half, simultaneously.

92. Recent simplex lehr installation. *Glass Ind.*, **2,** 24 (1921).—Description of installation at the plant of the Federal Glass Co., Columbus, Ohio.

93. Devitrification and revitrification of glass. J. B. KRAK. *Glass Ind.*, **2,** 29–31 (1921).—A brief discussion of the nature of these changes and the circumstances under which they occur.

94. Glass melting in shallow pots. *Sprechsaal*, **53,** 205 (1920).—Translated by H. W. CRAVER in *Glass Ind.*, **2,** 32–4 (1921); cf. *Cer. Abstracts*, **3,** 929.

95. Evolution of the mold industry. GEORGE B. ARDUSER. *Glass Ind.*, **2,** 35–6 (1921).—A brief statement chiefly relating to present practice.

96. Saving fuel by controlling chimney losses. F. F. UEHLING. *Glass Ind.*, **2,** 37–9 (1921).—*In the average boiler plant,* 35 per cent of the heat generated is lost in gases going up the stack, while only 4 per cent is lost by radiation and only 4 per cent is lost in unburned coal. The excessive loss up the stack is usually due to lack of instruments for determining whether the proper amount of air is being supplied. The percentage of CO_2 is the most important index. CO_2 recorders should be in every plant, and fireman should be instructed to keep the CO_2 content close to the maximum safe percentage.

97. Automatic bottle manufacture. GEORGE E. HOWARD. *Glass Ind.*, **2,** 55–9 (1921).—A discussion and comparison of the Owens process and the more recent feeder processes of bottle manufacture, by the inventor of the Howard feeder.

98. Bloomery furnaces and other turned pieces made on a potters wheel. A. H. WESSELY. *Sprechsaal*, **54,** 1–2 (1921).—A brief description of an old art.

99. Fuel and heat used in glass works. H. MAURACH. *Sprechsaal*, **54,** 36–8 (1921).—The quantities of coal used per annum by the *German glass industry* from 1913 to 1920 are given and also a comparison of the coal used per annum by the lime, glass and porcelain industries before and after the war. The importance of conserving fuel is emphasized and in that connection data are given as to the *thermal efficiency of typical glass furnaces*. Of the heat obtained from the coal, 15 per cent is lost in the producer, 19 per cent goes up the stack, 43 per cent is lost by radiation and conduction from the furnace itself and 10 per cent from the conduit pipes and regenerators, and only 12.5 per cent goes into the glass. It is stated that in practice from 1 to 1.3 lbs. of coal are required to produce 1 lb. of glass. C. G. W.

PATENTS

100. Glass; artificial stone. P. B. CROSSLEY. Brit. 152,780, July 22, 1919. Non-fragile glass, which can be rolled, forged, extruded, cast, etc., is made by dissolving in the dry state such silicates as micaceous or asbestos minerals in molten glass or similar silicate. The glass, etc., is chosen so as to melt at a temp. below the temp. at which the mica, etc., effloresce. If the product is to be machined, an excess of mica, etc., should be present over the amt. required to form a satd. soln. (*C. A.*)

101. Preparing glass, china and like surfaces for varnish. F. MEYER. Ger. 319,744, July 8, 1919. Addition to 317,656 (C. A. **15,** 183). The glass, china or like surface is roughed by means of H_2F_2. (*C. A.*)

102. Sheet-glass-drawing apparatus. JAMES WHITTMORE. U. S. 1,362,378, Dec. 14, 1920. A sheet glass drawing apparatus having a tank with a free lateral outlet through which the glass may flow and a travelling drawing conveyor. A cooled metal drawing lip below the level of the glass, over which the glass flowing out from the tank may be drawn.

103. Double ring for glass factories. JOSEPH DURIEUX. U. S. 1,367,027, Feb. 1, 1921. A glass drawing ring including an inner and an outer wall of semi-elliptical outline and disposed in parallel spaced relation, straight walls connecting the respective ends of the semi-elliptical walls and disposed in spaced relation, the inner wall being of greater depth than the outer wall, and spacing webs disposed between and connected to the curved or semi-elliptical walls and the straight walls. C. M. SAEGER, JR.

See also Abst. No. 72.

Enamels

104. The phosphorescent sulfides and their applications. A. A. GUNTZ, *Chimie et industrie*, **4,** 597–611 (1920).—A general review of the history of the phosphorescent sulfides, the theories advanced to explain their action, their principal properties, and the various industrial applications to which they

have been put, including those depending on the action of ultra-violet light, X-rays, Ra and other radioactive substances and light. A. P.-C. (*C. A.*)

PATENTS

105. Radium luminous coatings. E. O'HARA. U. S. 1,364,950, Jan. 11. Watch or clock dials or similar articles are enameled, luminous markings are applied over the enamel and the markings are covered with a protective coating free from Pb and vitrified on the luminous surface. U. S. 1,364,951 relates to a similar method of prepg. luminous dials in which the luminous material, *e. g.*, Zn sulfide $RaBr_2$, is mixed with a reflux or glaze which is fired or vitrified on the surface after application as a coating or marking. The glaze may be a potash lime glass. (*C. A.*)

106. Soldering enamel ware, etc. W. B. JOHNSON-LAIRD. Brit. 153,445, Oct. 10, 1919. In tinning and soldering porcelain enamel ware, the solder is applied to the glazed surface of the enamel or to both the enamel and any exposed Fe portion, by the use of a steel brush or other steel tool without the aid of a soldering-iron or flux. The surface is cleaned and brightened and the vessel then heated over a gas ring, etc. Solder is then applied by the steel tool, etc., until the surface is tinned and more solder is then applied. The solder may consist of 30% of Sn, 10% of Zn and 60% of Pb. According to the provisional specification, the solder may consist of 75% of Sn, 15% of Zn and 10% of Pb. (*C. A.*)

Brick and Tile

107. Comparative cost of steam and electric power in the brick industry. O. C. Cordes, *Clayworker*, **75**, 251–2 (1921).—

POWER COST PER 1000 BRICK

Class of Plant	Steam operated	Electrically operated	Difference	Saving % by elect. drive
Common face and tapestry brick:				
Soft mud	0.38	0.15	0.23	61
Machine made	1.23	0.96	0.27	46
Stiff mud	0.90	0.59	0.31	35
Paving brick	1.01	0.79	0.22	46
Fire brick:				
Machine made	1.23	0.97	0.27	46
Pressed brick	0.30	0.16	0.14	47

The price of coal was taken at $4.50 per ton and the price of electric power at 2.5 cents per Kw. hr.

108. The handling and shipping of brick. R. TWELLS. *Clayworker*, **75**, 226–7 (1921).—More careful handling of brick is urged. The use of gravity conveyors is recommended since they prevent the brick from being broken and permit more exact shading of the same.

109. The Chicago method of firing brick. F. H. LAMBERT. *Clayworker*, **75**, 244–8 (1921).—The method used for firing scove kilns is described. The

manner in which the hot zone travels from the bottom to the top of kiln is illustrated with diagrams.

110. Mechanical handling of brick. R. C. PENFIELD. *Clayworker*, **75,** 241–4. (1921).—A brick setting mach. picks up 750 to 1000 bricks in one operation and places them in a kiln. A similar mach. also takes 750 to 1000 bricks out of scove kilns. This system can be adapted to small plants of 50,000 brick capacity as well as at larger plants.

111. Remarks upon a new ordinance for the proper construction of chimneys. I. H. WOOLSON. *Clayworker*, **75,** 228–30 (1921).—The new ordinance advocates the lining of all flues not only to make better fire protection but also because of better draft. Losses due to defective chimneys and flues stand third on the list as productive of the greatest fire losses averaging about $14,000,000 each year.

112. Drying brick and tile. J. L. BUCKLEY. *Clayworker*, **75,** 237–8 (1921).—In the Procter system of drying, the air blows across the drier and not lengthwise as is the case with other driers. Temp., air circulation and humidity can be controlled in the system. Glass pots, high tension insulators etc., can be successfully dried in humidity driers in comparatively short time.

H. G. SCHURECHT

113. Possible uses for the spent shale from oil shale operations. KIRBY THOMAS. *Chem. Met. Eng.*, **24,** 389–90.—The spent shale might be used for *brick making* and in the manufacture of portland *cement*. H. F. S.

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Cement, Lime and Plaster

115. Notes on the dusting of cement clinker. E. ANDERSON. *Concrete (Mill Section)*, **18,** 140 (1921).—In the course of an investigation on the volatilization of alkalies from cement materials, the so-called dusting of the resulting clinker was frequently observed. The results indicate that although in actual mill practice, extreme cases of dusting probably occur only when the material is unduly high in SiO_2, this does not necessarily prove that the high SiO_2 content is the chief cause. It seems probable that dusting can occur as a direct result of low kiln temps. or insufficient heating.

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116. More observations on the effect of sea water on concrete. ANON. *Eng. News-Record*, **86,** 121–3 (1921).—On the Pacific Coast, from Santa Monica to Huntington, Calif., all the concrete pleasure piers with the exception of one built last summer show signs of disintegration. In general the effect is most marked between the levels of high and low tide, and along the line of reinforcement. A report is also made on the tests being carried on by the Aberthaw Construction Co. at Boston. J. C. WITT (*C. A.*)

117. Modified Vicat apparatus for study of setting time of cement. A. L. MOORE. *Eng. News-Record*, **86,** 70 (1921).—The app. consists essentially of an ordinary Vicat app. in which the movable vertical rod is attached to a beam carrying a counterpoise on the other end. A reading is taken by finding the wt. necessary to cause the needle to penetrate $^3/_4$ in. into the test piece. A number of curves show the effect of various percentages of H_2O, and the results obtained by different operators. J. C. WITT (*C. A.*)

118. Cement, its inspection and testing. E. J. MASON. *Can. Eng.*, **40,** 225 (1921).—Descriptions are given of the methods in use at the Engineering Materials Laboratory, Hydro-Electric Power Commission of Ontario, reprinted from the Hydro Bulletin. J. C. WITT (*C. A.*)

119. Tentative specifications for masons' hydrated lime. ANON. *Proc. Am. Soc. Testing Materials*, **20,** Part I, 605–8 (1920).—The specifications cover chem. properties and tests, physical properties and tests, packing and marking, inspection and rejection, methods of test. E. H. (*C. A.*)

120. Tentative specifications for gypsum. ANON. *Proc. Am. Soc. Testing Materials*, **20,** Part I, 609–11 (1920).—The specifications cover forms and sizes, sampling, chem. properties, physical properties, pack and marking, inspection and rejection. E. H. (*C. A.*)

121. Tentative definitions of terms relating to the gypsum industry. ANON. *Proc. Am. Soc. Testing Materials*, **20,** Part I, 658–77 (1920). E. H. (*C. A.*)

122. Tentative specifications for calcined gypsum. ANON. *Proc. Am. Soc. Testing Materials*, **20,** Part I, 612–5 (1920).—The specifications cover classes and sizes, sampling, chem. properties, physical properties, calcined gypsum for molding or casting, packing and marking, inspection and rejection. E. H. (*C. A.*)

123. The action of chemicals on concrete. M. JACOBSON AND J. G. DE KÈRAVENANT. *Industrie chimique*, **7,** 391 (1920).—Brief review of the action of acids, acid salts, alkalies and alk. salts, coal-tar derivs., fertilizers, oils and fats on concrete. A. P.-C. (*C. A.*)

124. An application of the vapor pressure of potassium compounds to the study of the recovery of potash by volatilization. DANIEL D. JACKSON AND JEROME J. MORGAN. Columbia Univ. *J. Ind. Eng. Chem.*, **13,** 292 (1921).—The presence of water vapor in contact with silicate mixtures containing potassium increases the volatilization of the K during calcination, owing to the high vapor pressure of KOH. Potash is volatalized at temperatures as low as 1215°C from mixtures of feldspar with $CaCl_2$ and lime in the proportion necessary to give a *Portland Cement clinker* and also more readily from a mixture of glauconite with lime and $CaCl_2$. If the temperature is kept below the fusion point, potash can be readily volatilized from mixtures of green sand with a chloride (in the proportion to give KCl) and limestone (in proportions much lower than those used in Portland cement). In volatilizing potash as a chloride the presence of water vapor has no advantage. ED.

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117. Modified Vicat apparatus for study of setting time of cement. A. L. MOORE. *Eng. News-Record*, **86**, 70 (1921).—The app. consists essentially of an ordinary Vicat app. in which the movable vertical rod is attached to a beam carrying a counterpoise on the other end. A reading is taken by finding the wt. necessary to cause the needle to penetrate $^3/_4$ in. into the test piece. A number of curves show the effect of various percentages of H_2O, and the results obtained by different operators. J. C. WITT (*C. A.*)

118. Cement, its inspection and testing. E. J. MASON. *Can. Eng.*, **40**, 225 (1921).—Descriptions are given of the methods in use at the Engineering Materials Laboratory, Hydro-Electric Power Commission of Ontario, reprinted from the Hydro Bulletin. J. C. WITT (*C. A.*)

119. Tentative specifications for masons' hydrated lime. ANON. *Proc. Am. Soc. Testing Materials*, **20**, Part I, 605–8 (1920).—The specifications cover chem. properties and tests, physical properties and tests, packing and marking, inspection and rejection, methods of test. E. H. (*C. A.*)

120. Tentative specifications for gypsum. ANON. *Proc. Am. Soc. Testing Materials*, **20**, Part I, 609–11 (1920).—The specifications cover forms and sizes, sampling, chem. properties, physical properties, pack and marking, inspection and rejection. E. H. (*C. A.*)

121. Tentative definitions of terms relating to the gypsum industry. ANON. *Proc. Am. Soc. Testing Materials*, **20**, Part I, 658–77 (1920). E. H. (*C. A.*)

122. Tentative specifications for calcined gypsum. ANON. *Proc. Am. Soc. Testing Materials*, **20**, Part I, 612–5 (1920).—The specifications cover classes and sizes, sampling, chem. properties, physical properties, calcined gypsum for molding or casting, packing and marking, inspection and rejection. E. H. (*C. A.*)

123. The action of chemicals on concrete. M. JACOBSON AND J. G. DE KÈRAVÉNANT. *Industrie chimique*, **7**, 391 (1920).—Brief review of the action of acids, acid salts, alkalies and alk. salts, coal-tar derivs., fertilizers, oils and fats on concrete. A. P.-C. (*C. A.*)

124. An application of the vapor pressure of potassium compounds to the study of the recovery of potash by volatilization. DANIEL D. JACKSON AND JEROME J. MORGAN. Columbia Univ. *J. Ind. Eng. Chem.*, **13**, 292 (1921).—The presence of water vapor in contact with silicate mixtures containing potassium increases the volatilization of the K during calcination, owing to the high vapor pressure of KOH. Potash is volatalized at temperatures as low as 1215°C from mixtures of feldspar with $CaCl_2$ and lime in the proportion necessary to give a *Portland Cement clinker* and also more readily from a mixture of glauconite with lime and $CaCl_2$. If the temperature is kept below the fusion point, potash can be readily volatilized from mixtures of green sand with a chloride (in the proportion to give KCl) and limestone (in proportions much lower than those used in Portland cement). In volatilizing potash as a chloride the presence of water vapor has no advantage. ED.

BOOK

125. HOWE, H. E.: **The New Stone Age.** New York: The Century Co. 289 pp. (*C. A.*)

PATENTS

126. Coating compositions; bitumen. K. FRIEDRICH. Brit. 154,236, Mar. 27, 1918. A glaze for bricks, cement, etc., consists of cement, coloring matter, and an emulsion of a bituminous substance such as asphaltum, free from volatile oils boiling below 270°, with a soln. of an alkali such as Na_2CO_3, the emulsion being subjected to an oxidizing treatment, for instance, by adding BaO_2 before the addition of the cement. (*C. A.*)

See also Abst. Nos. 10, 48.

ACTIVITIES OF THE SOCIETY

The New Constitution and By-laws

May 2. Seventy-eight votes were cast on the question of the adoption of the new Constitution and By-Laws of the Society.

Affirmative—77
Negative —1
It is carried.

The Constitution and By-Laws as adopted will be published in the Year Book.

New Members received during April

Associate Resident

Anthony, Wm. R., Tauton, Mass., Foreman, Enameling Dept., Weir Stove Co.

Brooks, B. T., 25 West 43rd St., New York City, Chemical Engineer, Mathieson Alkali Works, Inc.

Cameron, C. V., Box V, Richmond, Cal., Supt., Pacific Sanitary Mfg. Co.

Cawood, Richard L., East Liverpool, Ohio, Vice-President and General Manager, Patterson Foundry and Machine Co.

Dunbar, George S., Columbus, Ohio, Secretary, Federal Glass Co.

Early, Joseph W., Dickson City, Pa., Supt., Early Foundry Co.

Fuller, J. R., 22 Highland Ave., Salem, Mass., Engineering Dept., Hygrade Lamp Co.

Lamborn, Lloyd, 118 East 28th St., New York City, Editor, "Chemical Age."

McMillan, H. B., Lincoln, Cal., Assistant Ceramic Chemist, Gladding, McBean & Co.

Paul, Joseph R., Newark, Cal., Enamel Foreman, Graham Mfg. Co.

Rapp, John A., 1244 Chicago Ave., Evanston, Ill.

Reedy, A. J., Battle Creek, Mich., Supt., A-B Stove Co.

Turnbull, Lance, East Liverpool, Ohio, Clay Products Salesman, Johnson-Porter Clay Co.

Waller, Alfred E., Lawrence Park, Bronxville, N. Y., Chief Engineer, Ward Leonard Electric Co.

Associate Foreign

Cote, A. U., Cooksville, Ontario, Canada, General Manager, Shale Brick Co.

Cuthbertson, M. R., Cerro de Pasco, Peru, S. A., Superintendent, Brick Plants.

Gardner, Wm., Hartington, Ontario, Canada, Gardner Feldspar Co.

Hesler, N. A., Montreal, Canada, General Manager, Consumers Glass Co. Ltd.

Jacobsen, Carl, 7 Malmogade, Copenhagen, Denmark, Professor in Ceramics, Technical High School.

Corporation

American Rolling Mill Co., Middletown, Ohio.

Charles Englehard, Inc., 30 Church St., New York City.

Whitall-Tatum Co., Millville, N. J.

The Art Division

The Art Division's activities have been chiefly those pertaining to organization and policy for the coming year.

Inquiries have been sent to active members and various officials in order to obtain their opinions and suggestions in regard to the general policy of the Art Division, as approved by the members at the meeting in Columbus.

The following Points have been discussed: 1. Acquisition of new members, 2. Research, 3. Exhibitions, 4. Industrial, 5. Educational, and 6. Publicity.

Directly these opinions and suggestions have been compared and classified, a summary will be submitted to the members of the Art Division for approval or criticism.

A considerable amount of work has been done pertaining to organization and the essential information. It is planned to begin active work early in July which will really be productive of results between that time and the next meeting.

(Signed): F. H. RHEAD, *Chairman*
M. C. FARREN, *Secretary*

Resolution to A. V. Bleininger.

Resolved; That the members of the Art Division, A. C. S. are in favor of a full time Secretary for the American Ceramic Society.

(Signed) F. H. RHEAD, *Chairman*
M. C. FARREN, *Secretary*

Heavy Clay Products Division

Report of the Joint Research Committee

American Face Brick Association.

The Common Brick Manufactures Association.

The Hollow Building Tile Association.

National Paving Brick Mfrs. Association.

Report No. 1 *June 16, 1921.*

Minutes of Executive Committee, Organization Meeting Held at Hotel LaSalle, Chicago, June 16, 1921.

In keeping with plans previously arranged, the chairman of the respective research committees of the four national associations of burned clay products manufacturers, named above, together with the secretaries of these associations, representatives of the Federal Government, universities, and the American Ceramic Society, met in Chicago on June 16th to perfect an organization through which the coöperation of the associations might be made effective in clay products research.

Those in attendance were—Messrs.:

P. H. Bates, U. S. Bureau of Standards.
A. V. Bleininger, Homer Laughlin China Co.
F. W. Butterworth, American Face Brick Assn.
M. B. Greenough, National Pav. Brick Mfrs. Assn.
R. D. T. Hollowell, American Face Brick Assn.
F. W. Lambert, Common Brick Mfrs. Assn.
R. B. Moore, U. S. Bureau of Mines.
R. C. Purdy, American Ceramic Society.
O. W. Renkert, Natl. Paving Brick Mfrs. Assn.
E. R. Sturtevant, Hollow Building Tile Assn.
E. W. Washburn, University of Illinois.

Mr. Hollowell, acting as Temporary Chairman called the meeting to order at 10:15 A.M.; The Executive Committee then proceeded to organize by the selection of these officers:

Chairman—F. W. Butterworth
Secretary-Treasurer—M. B. Greenough

Mr. A. V. Bleininger had already been selected as Chairman of the Technical Committee. He announced the members of his committee as follows:

A. V. Bleininger, *Chairman*.
R. H. Bates, U. S. Bureau of Standards, Washington.
R. C. Purdy, Am. Ceramic Society, Columbus, Ohio.
R. T. Stull, U. S. Bureau of Mines, Columbus, Ohio.
E. W. Washburn, University of Illinois, Urbana.

The Technical Committee then reported a plan of research which was approved by the Executive Committee in behalf of the four Associations.

The Chairman's presentation of the program is here quoted in full:

"The work will be divided into two parts—(1) Dealing with the study and investigation of commercial kilns, represented by the up-draft and the down-draft kilns, the continuous kiln of the straight tunnel type, the compartment continuous kiln and the tunnel car kiln. (2) Dealing with the study of the water-smoking and dehydration process, by the Bureau of Standards, the study of heat absorption throughout all the burning stages by the Ceramic

Department of the University of Illinois, the study of oxidation and vitrification stages by the Bureau of Mines, and experiments in the study of combustion and transmission of heat, in a semi-commercial kiln, by the Bureau of Mines at Columbus.

"The first part will constitute by far the most extensive part of the program and will involve the detailed study of the different types of kilns, not only from the standpoint of fuel consumption but particularly with reference to the rise of temperature throughout the kiln and the actual rates of water, smoking, oxidation and vitrification.

"It is proposed to study also the draft conditions, the combustion as taking place in different types of furnaces, the various heat losses, and the influence of the kiln, flue and stack dimensions upon the burning process.

"It is proposed that the Bureau of Mines send out well-trained experts to conduct this work at representative plants, selected for the purpose with special reference to securing a certain degree of freedom of action. By this is meant permission to be granted to make such burning changes as are apparent from the results obtained and to make notes of the effect of such changes. A complete study will be reported of each kiln examined, drawing from the observations made, all conclusions warranted by the facts.

"In addition, a questionnaire will be sent out by the committee to the industries concerned by means of which it is expected to obtain a certain amount of information which will help in drawing general conclusions.

"All of this information will be collected and treated from the standpoint not hitherto presented to the industries. It is expected to present the information collected by means of definite statements or definite recommendations in language that can be understood by all.

"The laboratory studies to be conducted at the Bureau of Standards and the University of Illinois are intended to furnish information concerning the methods of attack and the fundamental principles involved in the burning process and thus will supplement the kiln studies.

"In these investigations all purely theoretical features have been eliminated and only such work will be done as will throw direct light upon the phenomena involved in the burning process.

"Of particular interest will be the tests conducted on the semicommercial kiln to be erected by the Bureau of Mines at Columbus. In this kiln all the factors entering into combustion will be under control, such as the volume of air used for combustion, the intensity of the draft, the maximum and exit temperatures, and the rate at which the heat is transmitted to the ware. Thus it is expected to determine the effect of heavy or light fuel beds, the effect of long flame versus short flame coal, and other factors.

"It is to be noted, therefore, that the investigations will proceed along broad and comprehensive lines, and it is to be expected that the results will prove of interest and value to all of the ceramic industries.

"It is perhaps not too much to say that some of the results that may be expected will be of a more fundamental character than it is possible to realize

at the present time. It has always been the experience of such comprehensive investigations that many by-products, in the shape of important results that cannot be foreseen in the beginning, are obtained.

"The funds appropriated by the Heavy Clay Products Associations will be largely augmented by funds granted the Bureau of Mines by Congress and also by a contribution on the part of the Bureau of Standards. It is safe to say that the additional funds which will be made available are equal to at least twice and perhaps three times the amount contributed by the Associations."

In connection with the field studies of the Bureau of Mines, Mr. Bleininger emphasized the fact that permission would be sought to place men on various typical plants, to give them a free hand to conduct certain experiments upon representative kilns in process of burning, to follow up the effects of such experiments, and otherwise thoroughly to study the results of experimental operations. During the meeting, the facilities of the plants with which those present were connected, were tendered, and because of the value of the work, it is anticipated that ample numbers will thus be offered for experimentation.

In reference to a point raised by Mr. Lambert of the Common Brick Association, the meeting was assured that whatever steps were taken by the Technical Committee would be equally representative of the interests of each of the participating associations.

The Executive Committee voted to call a meeting of the entire membership of all the Association research committees about the middle of September, in Chicago, and there receive a progress report from the Technical Committee and to take such action as seems advisable at that time.

Adjourned 12:45.

M. B. GREENOUGH,
Secretary.

Organization of Joint Research Committee and Technical Committee

CONTRIBUTING ASSOCIATIONS

American Face Brick Association, R. D. T. Hollowell, Secretary, 110 South Dearborn Street, Chicago, Ill.

The Common Brick Manufacturing Association, Ralph P. Stoddard, Secretary, Schofield Building, Cleveland, Ohio.

The Hollow Building Tile Association, E. R. Sturtevant, Secretary, Conway Bldg., Chicago, Ill.

The National Paving Brick Manufacturers Association, Maurice B. Greenough, Secretary, 830 Engineers Building, Cleveland, Ohio.

JOINT RESEARCH COMMITTEE

Chairman: F. W. Butterworth, Western Brick Co., Danville, Ill.

Secretary-Treasurer: M. B. Greenough, 830 Engineers Bldg., Cleveland, Ohio.

Face Brick Members

F. W. Butterworth (*Chairman*) (as above).

William C. Koch, Twin City Brick Co., Pioneer Building, St. Paul, Minn

F. T. Owens, Ridgway Brick Co., Watsontown, Pa.

Common Brick Members

Frank Lambert (*Chairman*), Illinois Brick Co., Chicago, Ill.

Warren Griffith, Baltimore Brick Co., 708 Maryland Trust Bldg., Baltimore, Md.

H. C. Klemeyer, Standard Brick Mfg. Co., Evansville, Ind.

Hollow Tile Members

J. J. Amos (*Chairman*), Humboldt Brick Mfg. Co., Humboldt, Kansas.

F. F. Anness, Anness & Potter Fire Clay Co., Woodbridge, N. J.

F. R. Hale, Vigo-American Clay Co., Terre Haute, Ind.

H. R. Straight, Adel Clay Products Co., Adel, Iowa.

Chas. G. Deckman, Medal Paving Brick Co., 16311 Saranac Rd., Cleveland, Ohio.

Paving Brick Members

O. W. Renkert (*Chairman*), Metropolitan Paving Brick Co., Canton, Ohio.

W. W. Cunningham, Clydesdale Brick & Stone Co., Jenkins Arcade Bldg., Pittsburgh, Pa.

W. H. Lucketberg, Burton-Townsend Brick Co., Zanesville, Ohio.

Eben Rodgers, Alton Brick Co., Alton, Ill.

C. A. Miller, Barr Clay Co., Streator, Ill.

J. R. Thomas, Standard Brick Corporation, Crawfordsville, Ind.

F. L. Manning, Peebles Paving Brick Co., Portsmouth, Ohio.

W. C. Brown, Southern Clay Mfg. Co., Chattanooga, Tenn.

A. W. Shulthis (Western P. B. M. Assoc. coöperating), First National Bank, Independence, Kans.

F. G. Matteson (Western P. B. M. Assoc. coöperating), Purington Paving Brick Co., Galesburg, Ill.

TECHNICAL COMMITTEE

A. V. Bleininger, *Chairman*, Homer Laughlin China Co., East Liverpool, Ohio.

P. H. Bates, U. S. Bureau of Standards, Washington, D. C.

R. C. Purdy, *Chairman*, Heavy Clay Products Division, American Ceramic Society, Columbus, Ohio.

R. T. Stull, U. S. Bureau of Mines, Experiment Station, Columbus, Ohio.

E. W. Washburn, Department of Ceramic Engineering, University of Illinois, Urbana, Ill.

EXECUTIVE COMMITTEE

F. W. Butterworth (*Chairman*), Frank Lambert, J. J. Amos, O. W. Renkert, R. D. T. Hollowell, R. P. Stoddard, E. R. Sturtevant, M. B. Greenough.

JOURNAL AMERICAN CERAMIC SOCIETY

Preparation of Abstracts

Every article in THIS JOURNAL is to be preceded by an abstract prepared by the author and submitted by him with the manuscript. The abstract is intended to serve as an aid to the reader by furnishing an index and brief summary or preliminary survey of the contents of the article; it should be suitable for reprinting in an abstract journal so as to make a reabstracting of the article unnecessary. The abstract should, therefore, **summarize all new information completely and precisely.** Furthermore, in order to enable a reader to tell at a glance what the article is about and to enable an efficient index of its subject matter to be readily prepared, the abstract should contain **a set of subtitles** which together form a **complete and precise** index of the information contained in the article. This requires at least one and often several subtitles even for a short abstract.

In the preparation of abstracts, authors should be guided by the following rules, which are illustrated by the abstracts in THIS JOURNAL for February and March, 1921.* The **new information** contained in an article should first be determined by a careful analysis; then the subtitles should be formulated; and finally the text should be written and checked.

Rules

1. **Material not new** need not be analyzed or described in detail; a valuable summary of a previous work, however, should be noted with a statement indicating its nature and scope.

2. **The subtitles should together include all the new information;** that is every measurement, observation, method, improvement, suggestion and theory which is presented by the author as new and of value in itself.

3. **Each subtitle should describe the corresponding information so precisely** that the chance of any investigator being misled into thinking the article contains the particular information he desires when it does not, or vice-versa, may be small Such a title as "A note on blue glass," for example, is evidently too indefinite a description of information regarding "Absorption spectra of glass containing various amounts of copper-cobalt and chromium-cobalt." General subtitles, such as "Purpose" and "Results" should not be employed as they do not help to describe the specific information given in the article.

4. **The text should summarize the authors' conclusions and should transcribe numerical results of general interest,** including those that might be looked for in a table of physical and chemical constants, with an indication of the accuracy of each. It should give all the information that anyone, not a specialist in the particular field involved, might care to have in his note book.

5. **The text should be divided into as many paragraphs as** there are distinct subjects concerning which information is given, but no more than necessary. All parts of subtitles may be scattered through the text but the subject of each paragraph, however short, must be indicated at the beginning.

6. **Complete sentences** should be used except in the case of subtitles. The abstract should be made as readable as the necessary brevity will permit.

7. **The ms. of all abstracts must be typewritten and double or triple spaced.**

* The rules were prepared by the Research Information Service of the National Research Council. The Society is indebted to Dr. G. S. Fulcher of the Corning Glass Works (formerly with the National Research Council) for the rules and the illustrative abstracts.

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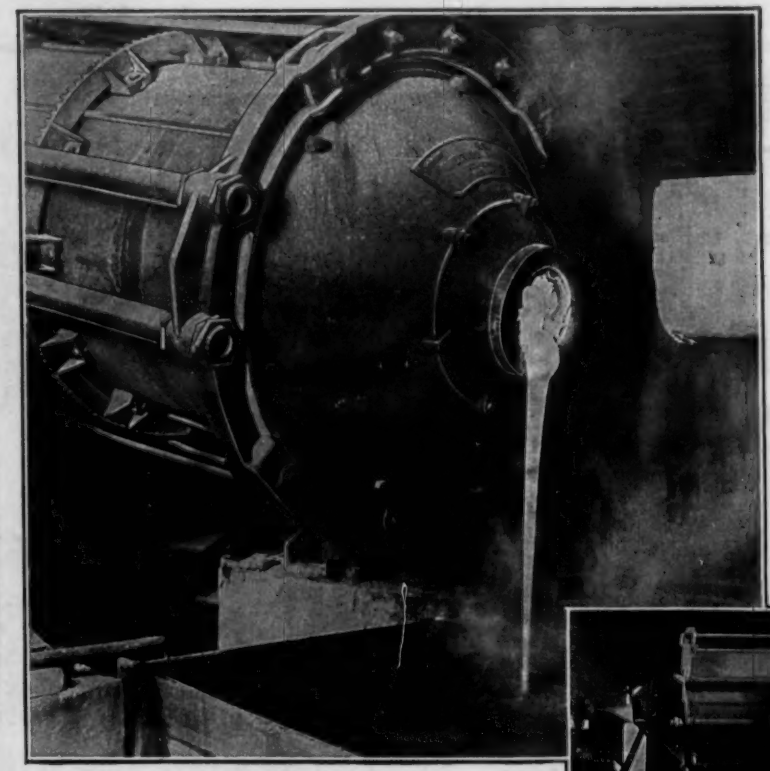

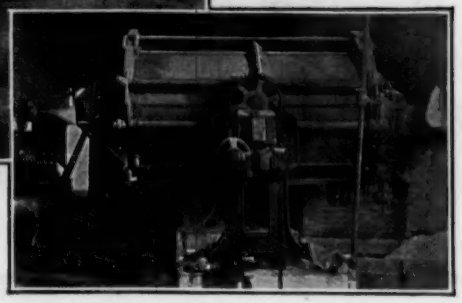

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12-21

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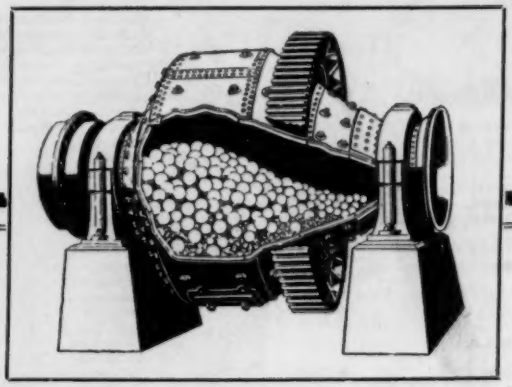

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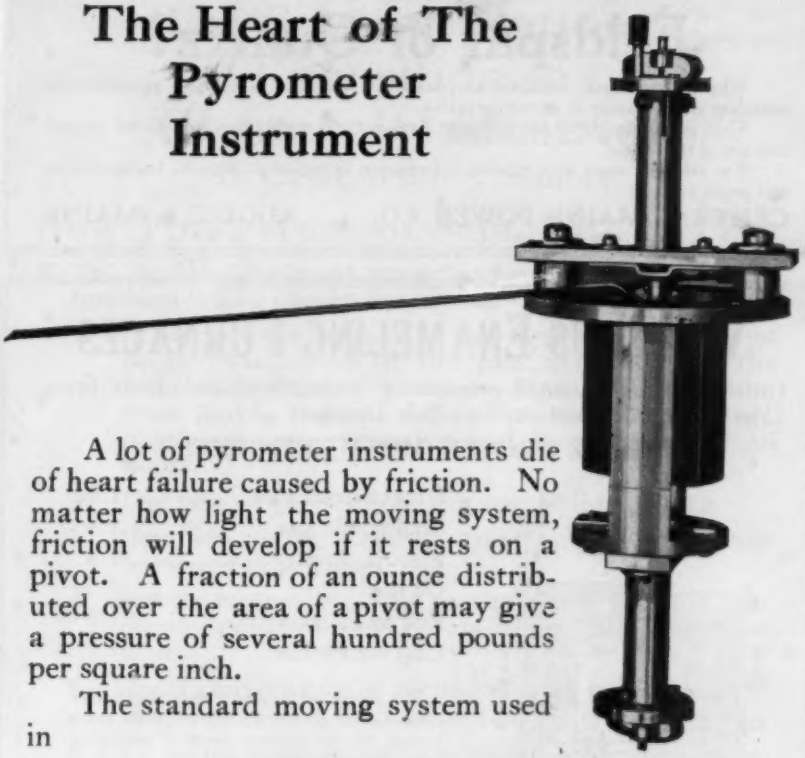

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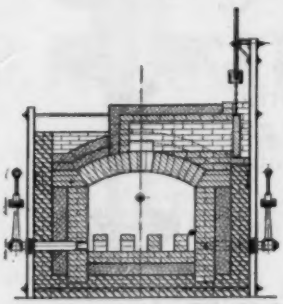

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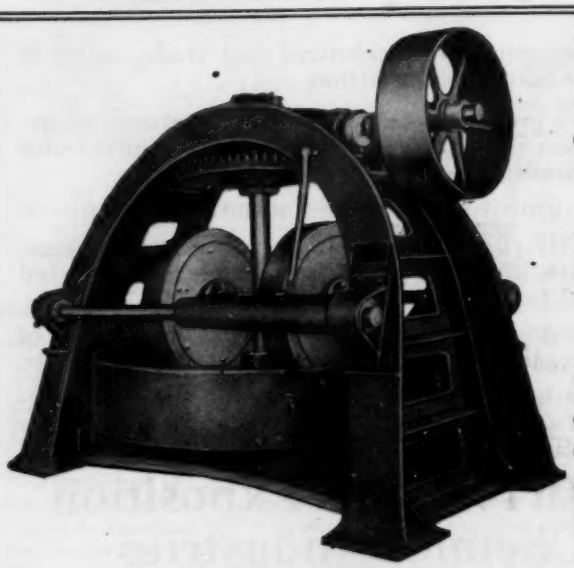

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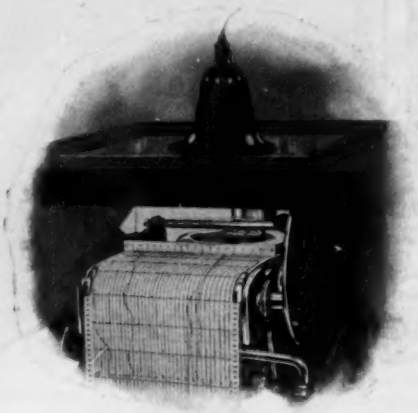

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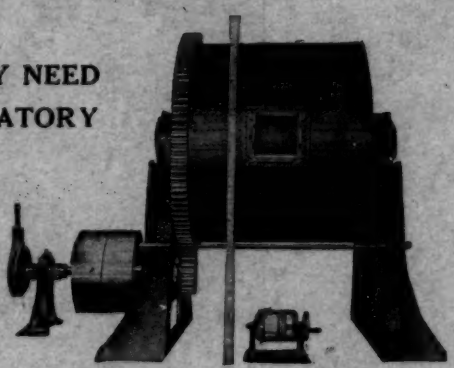

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Homer-Laughlin China Co., Newell, W. Va.

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Metal and Thermit Corporation,
120 Broadway, New York City

R. W. TILLOTSON,
Mellon Institute, Pittsburgh, Pa.

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American Ceramic Society

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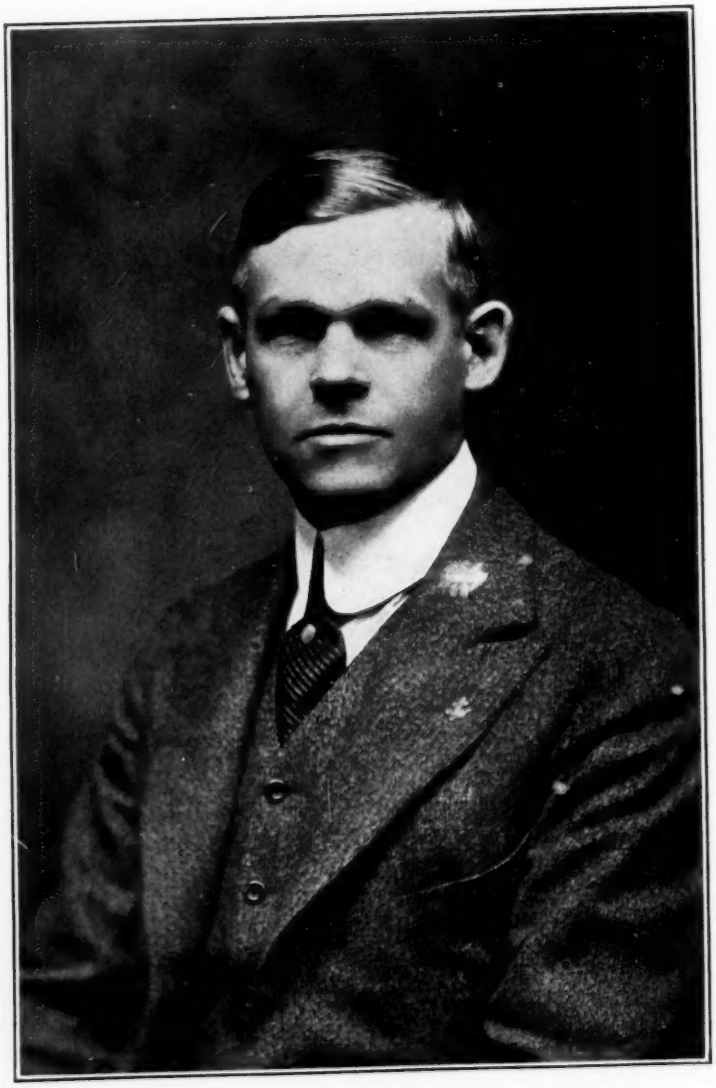
Year Book
1920-1921



R. H. MINTON

PRESIDENT, 1920-1921

OFFICERS, 1920--1921

President

R. H. Minton ..... Metuchen, New Jersey

Vice-President

E. T. Montgomery ..... Franklin, Ohio

Secretary

Charles F. Binns ..... Alfred, New York

Treasurer

R. K. Hursh ..... Urbana, Illinois

Trustees

R. D. Landrum, term expires 1921
M. F. Beecher, term expires 1922
F. H. Riddle, term expires 1923
H. F. Staley, Past President
R. T. Stull, Past President

EX-PRESIDENTS AND WHERE MEETINGS HAVE BEEN HELD

Herbert A. Wheeler	1899—1900	Columbus, Ohio
Karl Langenbeck	1900—1901	Detroit, Mich.
Charles F. Binns	1901—1902	Old Point Comfort, Va.
Ernest Mayer	1902—1903	Cleveland, Ohio
Edward C. Stover	1903—1904	Boston, Mass.
Francis W. Walker	1904—1905	Cincinnati, Ohio
William D. Gates	1905—1906	Birmingham, Ala.
Willard D. Richardson	1906—1907	Philadelphia, Pa.
Stanley G. Burt	1907—1908	St. Louis, Mo.
Albert V. Bleininger	1908—1909	Columbus, Ohio
Ross C. Purdy	1909—1910	Pittsburgh, Pa.
H. Ries	1910—1911	Trenton, N. J.
Charles Weelans	1911—1912	Chicago, Ill.
Arthur S. Watts	1912—1913	Washington, D. C.
Ellis Lovejoy	1913—1914	Wheeling, W. Va.
Cullen W. Parmelee	1914—1915	Detroit, Mich.
Richard R. Hice	1915—1916	Cleveland, Ohio
Lawrence E. Barringer	1916—1917	New York, N. Y.
George H. Brown	1917—1918	Indianapolis, Ind.
Homer F. Staley	1918—1919	Pittsburgh, Pa.
R. T. Stull	1919—1920	Philadelphia, Pa.

OFFICERS OF INDUSTRIAL DIVISIONS, 1920--1921

Art Division

Leon V. Solon, Temporary Chairman
F. H. Rhead, Temporary Secretary

Enamels Division

E. P. Poste, Chairman — R. R. Danielson, Secretary

Glass Division

S. R. Scholes, Chairman — E. W. Tillotson, Secretary

Refractories Division

A. F. Greaves-Walker, Chairman — R. M. Howe, Secretary

Terra Cotta Division

F. B. Ortman, Chairman — R. L. Clare, Secretary

White Wares Division

C. E. Jackson, Temporary Chairman
T. H. Sant, Temporary Secretary

OFFICERS OF LOCAL SECTIONS, 1920--1921

Pittsburgh District Section

C. R. Peregrine, Chairman — C. C. Vogt, Secretary
F. W. Walker, Councilor

Northern Ohio Section

A. F. Gorton, Chairman — Charles H. Stone, Jr., Secretary
R. D. Landrum, Councilor

St. Louis Section

I. A. Krusen, Chairman — Gail R. Truman, Secretary
C. W. Berry, Councilor

New England Section

C. J. Hudson, Chairman — M. C. Booze, Secretary
M. F. Beecher, Councilor

Central Ohio Section

M. B. Cheney, Chairman — J. D. Whitmer, Secretary
A. S. Watts, Councilor

Chicago Section

H. T. Bellamy, Chairman — F. L. Steinhoff, Secretary
C. W. Parmelee, Councilor

New York State Section

S. C. Linbarger, Chairman — J. B. Shaw, Secretary
L. E. Barringer, Councilor

Eastern Section

Abel Hansen, Chairman — G. H. Brown, Secretary
C. A. Bloomfield, Councilor

STANDING COMMITTEES, 1920--1921

Committee on Co-operation

E. W. Washburn, Chairman
S. G. Burt
F. B. Dunn
W. E. Emley
H. E. Maddock
T. Poole Maynard
G. A. Rankin
J. W. Sanders
F. L. Steinhoff
D. F. Stevens
F. W. Walker, Jr.

Committee on Membership

F. H. Riddle, Chairman
L. J. Frost
H. K. Kimble
A. A. Klein
S. C. Linbarger
Atholl McBean
F. H. Rhead
T. H. Sant
S. R. Scholes
Frederick Stanger
August Staudt
D. F. Stevens
Gail R. Truman
J. D. Whitmer

Committee on Papers and Programs

R. H. Minton, Chairman
Chas. F. Binns
M. C. Booze
G. H. Brown
A. F. Greaves-Walker
F. B. Ortman
E. P. Poste
S. R. Scholes
J. B. Shaw
F. L. Steinhoff
C. H. Stone, Jr.
Gail R. Truman
C. C. Vogt
J. D. Whitmer

Committee on Publications

L. E. Barringer, Chairman
A. V. Bleininger
H. Ries
H. F. Staley
E. W. Tillotson

Committee on Research and Development

G. H. Brown, Chairman
P. H. Bates
A. V. Bleininger
W. M. Clark
R. M. Howe
J. S. Laird
R. B. Sosman
R. T. Stull
E. W. Washburn
A. S. Watts

Committee on Rules

A. S. Watts, Chairman
R. L. Clare
R. K. Hursh
T. A. Klinefelter
J. B. Shaw

Committee on Sections and Divisions

S. C. Linbarger, Chairman
C. C. Ashbaugh
Leslie Brown
F. A. Kirkpatrick
R. D. Landrum
A. T. Malm
G. D. Morris
F. B. Ortman
C. W. Parmelee
E. P. Poste
E. W. Tillotson

Committee on Standards

M. F. Beecher, Chairman
C. W. Berry
M. C. Booze
E. E. F. Creighton
R. R. Danielson
E. C. Hill
R. M. Howe
R. K. Hursh
F. H. Riddle
J. B. Shaw
O. J. Whittemore
Hewitt Wilson

SPECIAL COMMITTEES

Summer Meeting, 1920

F. B. Ortman, Chairman
H. T. Bellamy
E. A. Brockman
W. D. Gates
J. W. Hasburg
R. K. Hursh
C. H. Jones
L. H. Menne
B. S. Radcliffe
F. L. Steinhoff
W. W. Wilkins

Joint Committee on Ceramic Research with National Research Council

A. V. Bleininger, Chairman
P. H. Bates
A. L. Day
R. T. Stull
E. W. Washburn

REPORT OF THE BOARD OF TRUSTEES
1920--21

The Board of Trustees is able to report a year of strenuous activity and a satisfactory financial situation. The accession of a large number of Corporation Members in 1919 added a considerable amount to the receipts of that year and enabled an important sum to be added to the investment fund. Such accessions are of course not of constant occurrence, but nevertheless the Society has met the obligations of the year, including over $1,100 to complete the publication of the Collective Index to the Transactions, and the accounts show a cash balance of $1,762.50.

In addition to the meetings at Philadelphia the Board met at the summer meeting in Chicago and transacted some important business especially in relation to the editorship of the Journal, one outcome of which has been that Dr. Washburn has accepted the position. Mr. Staley, who had been editor for the past year, was compelled to resign owing to a change of business which demands his entire time. The Board places on record its appreciation of the work of Mr. Staley during one of the most important periods of the Journal's career.

As in former years, most of the work of the Board has been carried on by mail and wire and their activities have been duly published in the Journal. The standing committees have continued their useful work and each will render a report in due form. The Board gratefully acknowledges the value of this work without which the functions of the society could not have been effectively performed.

The Industrial Divisions have carried on their special work. The Glass Division organized the tour of the English Society of Glass Technology which occurred last summer and successfully performed the arduous duties connected therewith.

The Divisions of Enamels, Glass, Refractories, and Terra Cotta have each added new names to the membership list and have prepared valuable programs for the present meeting. The Enamels Division has held an especially successful membership campaign, and the untiring efforts of the secretary, Mr. Danielson, are appreciated.

The new divisions which were projected last year have not yet fully materialized but they have not been neglected and plans for the fulfillment of the organizations have been gradually maturing. Conferences will be held on this occasion upon the organization of Divisions on White Wares and Heavy Clay Products, while a new development has arisen in a projected division of Ceramic Decorative Processes under the leadership of Mr. Leon V. Solon and Mr. Frederick H. Rhead.

The program presented at this meeting while not quite as large as that of last year differs mainly in the fact that the program of 1920 contained nearly 40 papers which had been published in the Journal, while the present list contains less than half as many. The new papers are in number considerably in advance of those of last year.

The Society was represented at the Chemical Exposition held in New York in September by a booth at which the Assistant Secretary was in constant attendance. The account of the meeting has been published in the Journal. The Board is of the opinion that provision should be made to continue this representation which is an excellent form of advertisement and that there should be provided a booth, roomy enough to form a real headquarters for members who are visiting the Exposition.

The membership list displays some changes. During the war period many members were carried on the honor roll and the policy was to retain every name which might possibly prove valid. It has now been thought desirable to bring the roster up to date by removing the names of those who are in arrears.

There have been four removals by death. Ernest Mayer, who passed away on December 13, 1920, was a charter member of the Society and the fourth president. He will ever be remembered as a man who was always ready to help a fellow-worker out of his difficulties and who was sought far and wide by those in trouble.

Robert T. Hall was a prominent manufacturer of East Liverpool and will be remembered from the fact that in company with Mr. Thomas H. Sant he secured 26 Corporation Members from the Ohio pottery companies.

Henry Schmidt was a young New York salesman whose genial presence was in constant attendance at the meetings and who rendered most efficient help in the organization of the activities connected with the Chemical Expositions in New York.

J. M. McClave was the general manager of the American Fire Clay and Products Company of Cleveland. He was well known at the meetings of the Society and his absence will be felt.

The Board places on record its appreciation of the work of the membership committee under the able leadership of the Chairman, Mr. F. H. Riddle. No membership has been allowed to lapse without one or more personal letters and in numerous cases these have been successful, bringing in the arrears of two and even three years. Two Corporation Members who had tendered their resignation were induced to withdraw the action. It is gratifying to note that a letter has been received from a firm of manufacturers stating that the information obtained through the pages of the Journal is worth many times the amount of their corporation membership. Two corporation memberships have been received from India.

The Summer Meeting was held in Chicago in August and the arrangements were admirably carried out by a local committee under the chairmanship of Mr. F. B. Ortman. There was a large attendance and a thoroughly enjoyable time was spent. It was hoped and expected that the English Ceramic Society would send a delegation to this meeting but the adverse rate of monetary exchange made it impracticable for the party to cross the ocean.

A departure has been made this year in sending out bills for dues on January 1st, instead of waiting for members to pay at the annual meeting. This has greatly increased the work of the office during the past two months, but the clerical work of this meeting will thereby be relieved. About $7,000 has already been received, which of course is placed to the credit of the current year.

The Society now has $9,938.58, invested in government securities, of which the par value is $10,700, and from which the income has been $413.64 during the year. The full financial statement is appended.

Including those regularly supplied to members and subscribers an average of 1426 copies of the Journal have been distributed monthly. The publication was brought up to date in the summer months, and this has since been the rule. The Board in consultation with the Committee on Publications has decided to print 2500 copies in 1921 so as to be sure of an adequate reserve.

The Collective Index of the 19 volumes of Transactions has been completed and was published in December. The total cost is $1,585.40. One hundred forty-three copies have already been sold at $1.50 each, and many commendations of the value of the work have been received. This expenditure is of course an investment which will gradually be repaid as the edition is disposed of.

The Board acknowledges the debt of the Society to the local committee who have carefully and thoroughly supervised the arrangements for the present meeting, and have thus greatly contributed to the comfort of those in attendance.

The Board has given continued consideration to the question of the appointment of a full-time Secretary-Editor. Careful study has been made of the functions of the Society and of the manner in which these have been met by the present mode of management. The Board is not prepared to admit that the work has failed. The function of publication is in itself an important stimulus to research and the general meetings as well as those of the Divisions and Sections offer valuable means of inter-communication. In fact the Society is a clearing house of technical and practical ceramic information. The Board is not of opinion that the appointment of a full-time Secretary would necessarily improve any or all of these activities or lead to others. Furthermore, the additional annual expense would certainly not be less than ten thousand dollars and the Board does not feel that the step would be justified in the present state of the available funds.

Financial Statement for Year 1920

Receipts

Balance in checking account, Jan. 10, 1920	$ 1,262.30
Certificate of deposit, Jan. 10, 1920 (see p. 34, 1920 Year Book)	5,000.00
Dues and fees, Active, Associate, and Corporation, including Division allotments	9,606.85
Volumes of Transactions sold	1,338.98
Subscriptions to Journal	1,312.01
Advertisements	5,259.00
Reprints	211.80
Seger's Collected Writings	262.50
Branner's Bibliography	12.66
Directory of Dealers in Ceramic Materials	7.00
Collective Index to Transactions	87.00
Partial return of insurance premium	3.78
Interest on Liberty Bonds and Treas. Certificates	413.64
Balance refunded from $5000 investment	61.42
Refund on Annual Meeting 1920	200.00
Miscellaneous	33.39
Total	$25,072.33
Bank charges for exchange and lost checks replaced by duplicates	23.16
Total amount transmitted to Treasurer	$25,049.17

Disbursements

Salaries	$ 4,329.91
Publishing Nov. and Dec. 1919 Journals	1,132.01
Abstracts, Nov. and Dec. 1919	157.25
Reprints, March, Oct., Nov., Dec., 1919	163.90
Publishing Jan. to Nov., 1920, Journals	6,752.47
Abstracts, Jan. to Nov., 1920	530.32
Reprints Jan. to Oct., 1920	461.80
Copyright, 12 issues, 1920	12.00
Expense of meetings	515.92
Collective Index to Transactions	1,129.10
Insurance, storage and purchase of volumes	358.66
Secretary's office equipment	102.05
Secretary's office expense	781.17
Editor's office expense	166.52
President's office expense	7.10
Treasurer's office expense	29.02
Traveling expense	711.53
Chemical Publishing Co. for Seger	218.46
Committee expense	385.57
Division expense	
Enamels	149.46
Glass	94.41
Refractories	2.75
Terra Cotta	7.75
White Wares	3.50
Dues and fees, charged by bank for lost checks	21.00
Foreign exchange charged by bank	2.16
Dues to International Chemical Union	13.42
Miscellaneous	70.62
Investment in Liberty Bonds	5,000.00
Total	$23,309.83
Amount paid out from University Bank for exchange and lost checks	23.16
Total	$23,286.67
Free balance in bank at Urbana	1,762.50
Total	$25,049.17

Membership

Accessions in 1920

Corporation Members	18
Resident Associate Members	176
Foreign Associate Members	30
	224

Losses in 1920

Deceased	
Resident Active Members	2
Resident Associate Members	2
Resigned	
Corporation Members	3
Resident Active Members	2
Resident Associate Members	35
Dropped for non-payment of dues	
Resident Associate Members	39
Foreign Associate Members	2
	85
Transferred from Associate to Active	110

Status, February 11, 1921

Honorary	3
Life	2
Active Resident	294
Active Foreign	14
Associate Resident	821
Associate Foreign	109
Corporation	105
Total	1348

Respectfully submitted,

CHARLES F. BINNS, Secretary.

PRESIDENTIAL ADDRESS

"Some Problems To Be Solved"

As we close another year in the progress of our Society it seems worth while to pause for a moment and briefly review the aims and accomplishments of the past year before proceeding to a consideration of the problems before us. Early in the year the present administration formulated a number of objects which might represent some progress for the year's work. First, the expansion of the Journal to cover a broader field and the enlarging of the abstract department to bring to the members the benefit of every published treatise in the ceramic field. Second, the drafting of a complete Constitution and By--Laws to replace the existing Rules, which are no longer in keeping with the growth and operation of the Society. Third, placing our Journal advertisements upon a strictly business basis by handling them through an experienced solicitor in order to make the Journal self-supporting. Fourth, the broadening of our activities to include other phases of the industries allied to the strictly technical, including co-operation with our Federal bureaus on important investigations, and co-operation with other technical organizations. Fifth, the development of a series of sessions at the annual meeting of the Society and the various divisions for the presentation of data upon the practical factory problems. Sixth, the formation of the White Wares Division and the extension of the activities and membership of the Society to include the Heavy Products Manufacturers and the Decorative Arts allied with ceramics.

When we last met our industry was passing through the peak of a very prosperous period. Since then the country has gone through one of the most precipitate business recessions in its history. In spite of the adverse conditions our Society has progressed. We have grown in membership, to the extent of more than 10%; we have finished the year with a substantial financial balance in spite of greatly increased expenditures; we have improved the Journal and laid a solid

foundation for our business affairs; through the Industrial Divisions we are emphasizing the value of co-operation among the related industries; we have developed a greater spirit of progress and we are proving by our works that our Society is of increasing service to the ceramic industries.

Shortly before our last meeting in a letter to the members of the Society the following statement was made: "America was not prepared for war. The past year has shown that we were even less prepared for peace. The real problems of peace are before us and they will be more difficult ones than were brought by the war. The right spirit of co-operation among the members of the American Ceramic Society will enable the industries represented to successfully prepare for any and all problems which the future may bring." In the belief that our country now faces a period in which industrial competition will be much more severe than at any time during the past twenty years it seems well to consider some of the problems whose solving will aid in elevating our industry to a higher plane of efficiency and success.

Technical Problems

When we consider that oxygen, silica and alumina form approximately 85% by weight of the elements of the earth we can form some conception of the magnitude of the foundation upon which the ceramic industry stands. In spite of much theorizing and experimental work by mineralogists, physicists, and chemists there is comparatively little known of the real nature of the constitutions of the silicon compounds, which form such an important place in the inorganic world. Through the application of extensive scientific investigation to these materials many industries would be benefited and no doubt new ones created. The past two decades have seen an enormous development in the chemistry of the carbon compounds. It is not unlikely that the future will see a similar development in the chemistry of the silicon compounds. All the reactions involved in the processes employed in the conversion of raw materials into finished ceramic products depend upon the fundamental laws of chemistry and physics, and real and last-

ing success can be achieved only as our work is in harmony with these laws.

Although the ceramic industry in some branches antedates possibly any other modern industry it has been the slowest to make use of applied science in solving its problems. This is no doubt largely because the industry itself had developed as far as it could on empirical lines before modern chemistry was discovered. For this reason it held to its traditions and persisted in holding aloof from all technical and scientific applications. Until recent years we were content to drift along, but the pressure from foreign competition which was felt before the war caused many a manufacturer to realize that secretly guarded methods were no barrier against technical competition. The war caused us suddenly to realize that our former slipshod methods of inefficient individualism were no match, industrially, for the thoroughly organized technical team-work of German industry.

The war proved a powerful stimulus to research work in our industry, especially in glass, refractories, porcelains, and in the search for raw materials to substitute the foreign ones previously used. However, the ceramic industry can never be raised to the highly technical development of many other industries because of the very nature of our raw materials. Instead of having raw materials which are chemically pure and subject to exact chemical control we are dealing with impure and often constantly changing compounds and mixtures. It is because of these conditions that our industry is in need of every means of technical control available and it will never be possible to regulate its processes by purely mechanical or automatic methods.

The problems with which we must deal are chemical and physical on the one hand and mechanical and human on the other. From the chemical and physical standpoint we are weak in fundamental data. In fact, until the war, at least. America has not done a great deal of fundamental research which can be said to be advancing the sciences. In spite of our intensified work on dyestuffs our processes are still so undeveloped and costly that the du Ponts have recently found

it necessary to employ two German dye experts at very large salaries. During the war our Government was deluged with inventions and suggestions, but the records of one board show that more than 95% of all the inventions examined were without military value. Another board examined sixteen thousand plans and devices submitted by so-called inventors, and of them all only five had sufficient merit to warrant further consideration. It is evident that our fundamental problems can be solved only by men highly trained in chemistry and physics.

Among some of the general problems involving certain fundamental laws may be mentioned those involving the drying and firing of clay products; heat transmission and heat losses; problems of combustion, which include the whole process of kiln construction, kinds and forms of fuel, and the firing methods and controls. Many of these, and related problems, are, of course, works problems, but they are all based upon laws about the operation of which we have little knowledge and data.

Each industry has its own peculiar problems. The glass manufacturers need knowledge of the chemical reactions and the physical properties involved in the use of different materials and compositions. They are interested in learning more about heat treatment, annealing, solubilities, etc. We should know more of the actual chemical constitution of glasses, and whether we are dealing with definite compounds or mixtures. A study of the comparative chemistry involving the differences in the physical and chemical properties of the various primary and secondary forms of silica has hardly been more than outlined. Exact knowledge of the conditions and the temperatures governing their transformation would be of great importance to the ceramic industry, especially for silica brick, quartz glass, and porcelains.

There is also a great need for investigation into the constitution and properties of glazes and their relation to ceramic bodies of various compositions. The collection of data which will give a better understanding of the problems of crazing and its control is highly important. Much remains to be

done in learning the relations between the compositions of glazes and frits and the solubilities of lead glazes.

In the field of refractories there is much room for improvement and development. Further high temperature work in laboratory and plant is dependent upon corresponding development in refractories. The increase in efficiency in kiln construction and firing methods rests largely upon suitable refractories. A possible great field in clay refractories lies in the utilization of undergrade kaolins. Among the artificial refractories the future promises great advancement in the use of sillimanite, aluminum, zirconia, magnesite, and carborundum. All of our industries which have need for saggers and slabs recognize these as one of the vexing problems calling for solution.

Both the glass manufacturers and the refractories manufacturers are in need of data which will lead to standard specifications for glass house refractories. To date considerable work has been done toward arriving at satisfactory specifications pertaining to porosity and volume change of blocks, and softening points of pot clay mixes. Other data needed are those pertaining to hot bending of pot clay bodies and pot arch heating schedules. Much remains to be learned regarding the fluxing action of glasses and their various ingredients on the clay pots and tank blocks. More data on the casting of glass pots and tank blocks should prove of great value. This method is used in many plants abroad and is claimed to be much superior to the old method of pressing. Such data and the resulting specifications can be worked out satisfactorily only by co-operation between our Glass and Refractories Divisions. Such specifications as are formulated by the joint action of the Standards Committees of these two Divisions, acting in conjunction with our Committee on Standards, would have the authority of the Society.

Other problems requiring investigation are those involving the disintegration of clay products from weathering, the dunting of sanitary and terra cotta bodies, the failure of refractories under load, and the improvement of porcelains for high tension work.

Then there is the question of plasticity of clays. While there are many theories as to the cause of plasticity little is actually known. It seems fairly evident that this property is more or less connected with the water of constitution. A thorough study of this question would throw light upon the methods by which plasticity might be artifically increased. This is a most important question in relation to our white wares industry, where the use of more plastic china clay and kaolins would permit the elimination of ball clays. In a general way we have not greatly improved the quality of our pottery wares, and in order to manufacture a product that compares favorably with the European hard porcelains ball clays must be omitted from the body. In this connection also may be mentioned the importance of further investigation into the field of colloidal chemistry and its bearing upon ceramic processes.

Our White Wares Division should have a committee to investigate new deposits of raw materials and collect data that will lead to specifications for clays, flints, spars, etc. Our manufacturers do not have the knowledge and control of their raw materials that is necessary for exact control methods of production. This is especially noticeable in comparison with European methods where all materials are purchased in the crude condition and all sorting, refining, grinding and blending is done at the works.

Mechanical Problems

In all the ceramic industries there is great room for advancement and improvement in mechanical equipment of all kinds. In most of the plants now in operation mechanical means of transportation in various stages of the process could be used to advantage. Especially in the heavy, crude products industries is it desirable to perfect the entire system to more closely approach automatic procedure with the greatest possible elimination of labor. In Germany there is a plant now in process of being equipped with automatic machinery by which, it is claimed, finished brick will be ready for shipping just six days after the raw clay is dumped into the brick ma-

chine. The brick are made by the stiff mud process, mechanically placed upon cars which automatically move into a humidity dryer where they are dried in eighteen hours. From the dryer the cars move into a tunnel kiln and are fired in less than 96 hours.

In the pottery industry there is need of further labor-saving machinery. Among these might be mentioned the automatic batting-out machine as used in England and Germany, the casting machine used in England, and the automatic cup jigger used in Germany. There is also need for more mechanical conveying methods. Perhaps one of the important problems needing solution is that of a continuous, or semi-automatic filter-press, eliminating the cloths. There are a number of semi-automatic or semi-continuous filter presses in use for handling mine sludge, paints, and other non-plastic materials but they all fail when tried with plastic clays.

In England there has been perfected recently a semi-automatic machine for de-watering and classifying clays, which is known as the Gee Centrifugal Separator. This machine works on the centrifugal principle and while it is entirely successful in removing the water from a clay slip it has the unfortunate fault of also grading the materials into sizes. One large china clay company is at present using this system for preparing its clays for the market. For certain cruder clay products this system might be of considerable value.

During the war cotton fabric became so scarce in Germany that elaborate experiments were conducted to perfect a process that would replace the press using filter cloths. Exhaustive tests were made with the various types of centrifugal machines and they were finally rejected, as it was found that too great separation of the constituents of the body took place. The same conclusion was reached regarding all machines depending upon the suction and vacuum principles. Repeated investigations with different methods of operation achieved no success, for it was found that the greatest possible vacuum was not sufficient to remove the water as soon as a thin layer had formed in the apparatus.

The electro-osmose system has been sufficiently developed that there is no question but that it will de-water clays without any resulting separation of sizes. At the present time this method is entirely too costly for practical application in factories on account of the cost of installing and the expense of operating.

One of the most interesting continuous filter machines consisted of a column of thin metal rings held by bolts, by which they could be held together tightly or loosely. This sheet metal column is set in the middle of a cylindrical drum and tightly closed. The slip is fed by pressure into the space between the drum wall and the disc column. The water is forced between the discs to the inside of the column while the filtered material collects on the outside of the column. The economical advantages of such a machine are evident and without doubt a continuous filtering apparatus of some sort is a certainty in the near future.

Standardization

The question of standardization of many of our methods and products deserves serious consideration. In every line there is a multiplicity of designs, shapes, patterns, and sizes which might well be restricted by the proper co-operation. It was only through the war that we began to realize the waste through unrestricted duplication in production. The Refractories Manufacturers Association has begun the systematic standardization of their products and they are just beginning to realize the importance of this work and the benefits that will result. Our Refractories Division should co-operate with them on their problems.

In the sanitary industry there are many manufacturers making many different styles of many different articles. In each case a great deal of duplication is constantly adding to the cost of production. Then again we find many jobbers handling metal fixtures made to their own designs and sizes without regard to any standards. In the glass industry the necessity of standardizing certain wares is of urgent im-

portance. In the item of bottles and jars alone there are now between four and five thousand different sizes, shapes and kinds being marketed. Much of this output is used for marketing food products and the manufacturers should take the initiative instead of being compelled by the consumer to standardize these containers. In all of these matters the Standards Committees of our various Divisions might well supply the initiative.

Standardized Methods

We may well profit from the German industrial example in standardized methods of manufacture and mass production. This scientific organization, together with the intense application of scientific methods to factory production, has been the secret of Germany's rise in the industrial world and her rapid exploitation of the world markets. The inevitable outcome of standardized manufacture and mass production, if carried to its ultimate conclusion under our present system of distribution, is over-production. This was the result of the German system of producing first and finding the market afterward. We need not adopt it in its entirety with the insatiable desire to constantly lower costs which could only be achieved by constantly increased output. However, standardized methods based upon scientific principles will eliminate much waste and loss without carrying production to excess.

Research and Development

No engineer who has traveled in Germany and studied her industries can fail to realize that her great strength in commercial expansion, and in war, was due to the solid foundation of her organized research. Their industrial plan was fundamentally based upon research and organization, and her industries were designed for constant growth. Her technical and scientific men were considered the industries' greatest assets and there was the closest co-operation between all related branches of any industry. Germany has held science in the highest esteem, and while she has been less inventive than

other countries she has labored unceasingly. She has excelled in perseveringly perfecting and applying scientific control of all methods of production. It is interesting to note that in every industry the processes are all under the control and direction of technical men. The plant is run in absolute co-ordination with the laboratory; is, in fact, a huge laboratory. This, coupled with exact and intensely serious labor, accounts for their success against such great odds.

For our purposes deductive work in the basic sciences, chemistry and physics, is the most important. To do this requires extensive and costly apparatus which very few individual firms can afford. We must, therefore, turn to the government and the university laboratories. I would earnestly urge that this Society and the members of its various branches make definite plans for closer co-operation with these organizations. I cannot but feel that in the past there has been a lack of co-operation between our governmental and university laboratories themselves on the one hand and between them and the industries on the other. There would also be less duplication of effort, for often different laboratories are doing the same work. The number of investigations and their equipment is so limited and the field is so large that all efforts should be directed without waste.

Last year it was my desire and hope that the Society might officially make some investigations in conjunction with our Federal Bureaus. Upon being approached it was found that they either were too busy with other problems or they had not the time, or men, or money to co-operate. If these bureaus do not have the men it is because they do not have the money, and if they do not have sufficient money it is entirely because the industries that would be benefited do not make enough effort to help finance them or to see that they receive adequate appropriations.

Another great strength of the German industrial system was in the practical application of their scientific discoveries. It is useless to work out fundamental laws unless they are applied. In many German factories we find that the director is a college professor, devoting a part of his time to research, a

part to applying his science in the plant and a part to instructing future scientists. By the proper co-operation between our Society and our federal organizations we would be solving the problems which TODAY are retarding the industry.

For one thing might be mentioned what could be accomplished by the proper co-operation between our Society and the heavy products manufacturers. They have many problems to be solved, many of them similar to other branches. While their operations are based upon certain laws it would seem that the strict application of fundamental principles does not apply nearly so much as the solution of engineering difficulties. On account of the widely varying raw materials used in these industries the chemical and physical problems must be handled for each individual case. However, there are many engineering problems whose solution would greatly benefit the whole industry. For example, we need comparative data upon the results of the tunnel kiln and the continuous compartment type of kiln. We need to learn many things as to the type of kiln best adapted to different wares.

We need more investigation into methods of eliminating fuel waste in the firing of kilns already constructed. Many manufacturers cannot afford a continuous or tunnel kiln but must struggle along with existing equipment. Again, a tunnel kiln is so unsuitable to many existing plants that the saving in firing is offset by other adverse factors in operation.

There is also need that more attention be paid to the designing of plants and layout of machinery to effect the greatest possible efficiency of operation. Problems of this kind can better be worked out with the aid of construction and fuel engineers in co-operation with actual plant management than in the laboratory and there is no reason why this Society should not be the means of this co-operation.

Ceramic Training

In this connection it may be noted that we do not seem to be training men with the care that we should. Very few of our ceramists are competent to do real scientific research

work on account of the lack of proper training in chemistry and physics. On the other hand we do not take into consideration the executive and business side of the industry as fully as we should. Our graduates seem to have the idea that their training in ceramics has thoroughly fitted them for their life work. As a matter of fact success in industry depends more largely upon personality and business ability than technical knowledge. The men who have done successful research work have done it because they have continued as students. We should begin to direct our training of the technical men with a view to whether they will become research chemists, ceramists, engineers, or executives. This can be done only by close co-operation between the universities and the industries. We would profit by the German system where the factory is open to the university students to do research work on any problems, and to thoroughly grasp the application of science to practice.

Economic Co-operation

While our Society exists primarily for scientific and technical advancement, yet every individual member is influenced by economic conditions. The need of industry today is a market for full production and this cannot be created without foreign trade. There seems to be a strong impression today that what is needed to promote business is the erection of high tariff walls. We need to realize that foreign trade can exist only through the exchange of goods, and that the economic recovery of Europe is of vastly greater importance than high tariffs. The inability to trade with us means the economic collapse of Europe and this country cannot conceivably avoid the effects of a serious depression in the countries so adversely affected by the war. I would earnestly urge the members of this Society to give this question their most careful consideration before advocating a restrictive policy which will seriously hinder business recovery.

Industry faces a period today that will be quite different from the one just past. The most difficult problem of the past four years has been the labor problem. The big problem

in the immediate future will be that of management. In the development of our industrial system we have perfected the mechanical processes and largely forgotten the human element. We constantly hear of the antagonism between capital and labor and forget that the most important element in the system is management. Management represents the connecting link between capital and labor and is today probably the weakest member of the organization. The question of increased efficiency and lower costs is very largely a matter of mental attitude on the part of the worker. It is time for the leaders to find a means of conveying to the minds of the workers their own ideas and implanting the spirit of co-operation and the knowledge that by increased production only, can increased consumption be made possible. The question of the enlightened management of men in connection with efficient development of methods looms up as a large field for our engineers.

Perhaps the most important problem pressing for solution today is that of unemployment and continuous normal business. This is essentially an economic problem that can better be solved by engineers and business men than by politicians. Its solution is almost certainly dependent upon a drastic cut in government expenditures throughout the world, and this in turn is entirely dependent upon reduction of armaments. From the standpoint of human needs there is no reason why Industry should not continue to produce on the same scale as during 1917 and 1918. The whole world is in need of more goods and to fill this need and raise the general standard of living to a desirable plane would mean almost indefinite prosperity. Our economic structure collapsed because our financial system of exchange has failed, owing to unlimited expenditures. The huge cost of running the governments of the world through the war has made the overhead load so heavy that business is no longer able to carry it.

A concrete example of the present lack of constructive legislation is the chaos in the housing situation. The most logical means of transition from the present depression to normal conditions would be through the recovery of the building

industry. About forty percent of the ceramic industries would be directly affected by this, and much more indirectly. Yet we find Congress preparing to spend hundreds of millions of dollars upon increased armaments while they have not one constructive plan for solving the housing shortage. Here is a splendid opportunity for concerted co-operative action of all the organizations affected in formulating a definite, constructive plan and carrying it to a conclusion.

The Function of the Society

Recently there has been some discussion as to whether the Society is living up to its opportunities and properly filling the needs of its members and of the ceramic industries at large. It is stated that the principal, if not the only, function of the Society at present is the publication of the Journal, and that a great deal more might be done if its energies were properly directed.

There is no doubt but that the original function of this Society was to bring about a closer personal co-operation between the men engaged in the ceramic industries and to spread their knowledge through publication. If publication were impossible, except at great expense, it is obvious that a great amount of research and investigation would remain undone, and the greater part of what is done would not be generally available.

The function of publication is unquestionably an important one. In fact, it would seem to be the supreme activity of the American Chemical Society and of many other scientific and engineering societies. Thousands of men belong to these associations for the sole purpose of keeping in touch, through their publications, with the activities of others in their own field of endeavor. The first step in any investigation is to examine what has already been done. This can only be done through existing literature.

The function of the organization of meetings should not be underestimated. Every member who attends our meetings both of the Society and of the Divisions and Local

Sections, knows that he gains much through personal discussions, the renewal of friendships and the making of new acquaintances, that cannot be had in any other manner.

The question of the nature and extent of the activities of this Society is one which the members should consider and determine. The decision is squarely up to the members themselves and I am sure that the Board of Trustees would welcome a full expression of opinion from every member. In this connection it should be remembered that the members **are** the Society, and the Society as an organization can give only as it receives.

I have attempted to point out some of the problems calling for attention and to suggest some of the ways in which our work may be directed. We have in our organization the necessary foundation upon which to build according to any plans which our members are willing and determined to carry into execution.

Conclusion

In closing I wish to express my appreciation of the confidence placed in me by the members of this Society in honoring me with this office. While the work has occupied a considerable part of my time and thought, it has been a pleasure to be of some service. I want to thank the members of the Board of Trustees for their splendid co-operation at all times, and particularly do I want to express my appreciation of the support and assistance of the Secretary and the Assistant Secretary. I owe much to many of the members who have worked on committees and otherwise contributed to the work. As I step back into the ranks I do so with the desire that my experience may be of further use to the Society in all ways that may seem best, for I have no higher ambition than to help promote the interests of the American Ceramic Society and through it the Ceramic Industries of America.

REPORT OF THE COMMITTEE ON PRESIDENTIAL ADDRESS

The Committee respectfully submits to the President and Board of Trustees the following report on the Presidential address of Mr. R. H. Minton, made before the Society at the annual meeting held in Columbus, Ohio, on February 21, 1921.

Taking up in their order the suggestions made, we find:

First:—That the expansion of the Journal is being cared for by the Committee on Publications.

Second:—A new constitution and by-laws is in course of preparation.

Third:—The extension of advertising in the Journal is being properly cared for and has been placed in the hands of a competent advertising man.

Fourth:—The suggestion that the Society more closely co-operate with the Federal Bureaus on investigations is an important one. We believe that suggestions for these investigations should come from the chairmen of Divisions or Division Committees and be submitted to the Committee on Co-operation, or the Committee on Research and Development.

This Committee should attempt to have the Federal Bureaus, Technical Schools and Research Laboratories take up these problems, so that there will be no duplication and so that the industries affected will have their most troublesome problems worked out first. When a problem has been assigned, a committee should be appointed from the division interested, composed of men in close touch with the practical side, to act in an advisory capacity if called upon.

Fifth:—Sessions on practical factory problems can best be held by divisions at their regular meetings by the question box method. Any important results can be published in the Journal.

Sixth:—The formation of White Wares, Heavy Products and Decorative Arts Divisions is already under way.

Technical Problems

It is suggested that the various Divisions be asked to devote a meeting during the year to outlining the most important problems before the industry they represent and that this list with any suggestions, be presented as early as possible to the Committee on Co-operation or the Committee on Research and Development, for their action.

Mechanical Problems

It is suggested that a general session at the annual meeting be devoted to mechanical equipment, an effort being made to have the equipment manufacturers present their problems at that time. Practically every Ceramic equipment manufacturer in the country holds membership in the Society, but they have been given no encouragement to present papers, in the belief that advertising was uppermost in their minds.

The equipment manufacturers have received very little help from either the industry or the Society and much good can be done by the Society in fostering closer relations.

Standardization

While the standardization of manufactured products may properly be considered as belonging to the trade associations of the various industries, it is suggested that the Society actively offer its co-operation in all matters of standardization in which it might have an interest.

Standardization of Methods

In this matter also it is suggested that the Society take a more active interest. It is to be assumed that the trade associations will welcome any assistance the Society can give them.

Research and Development

It is a well known fact that our Federal Bureaus and State University Research Laboratories are hampered in their work by lack of money. It is the belief of the Committee that this condition can be bettered, at least, by an organized effort on the part of the Society to influence the granting of a larger appropriation for research purposes.

A few years ago the Ceramic Section of the Bureau of Standards was brought into being largely through the organized efforts of the Society, and larger appropriations can also be obtained by using the same methods.

With a technical man of high standing at the head of the Department of Commerce, this should be made much easier, but nothing will be accomplished unless the Society acts.

Function of the Society

It is the opinion of this Committee that the larger purposes of the Society include not only the holding of meetings and the publication of the Journal, but also embrace active co-operation with other Societies and organizations and the stimulation of Research through co-operation with the National Research Council. It is suggested that the Board of Trustees consider ways and means for fulfilling these purposes either through the better organizations of the present Committees or by the appointment of an officer of the Society who can give his full time to the work.

Respectfully submitted,

A. F. GREAVES-WALKER,
Chairman of Committee.

Approved by entire Committee.

COMMITTEE
A. F. Greaves-Walker, Chairman
E. Ward Tillotson
E. P. Poste

Pittsburgh, Pa., May 6, 1921.

REPORTS OF DIVISIONS, 1920--1921

Enamels Division

The Enamels Division during the past year has made marked progress both from the standpoint of membership and of awakened interest in the necessity and desirability for co-operative investigation of the problems of the industry.

The enrollment of the Division as reported at the last meeting of the Society was as follows:

Active members	10
Associate members	63
Corporation members	8
Total	81

The enrollment on Feb. 15, 1921, was increased to the following number:

Active members	16
Associate members	106
Corporation members	8
Total	130

During this period there was taken from us by death, an active supporter of our Division, Mr. Schmidt. There were three resignations consisting of two corporation and one associate member. The total net increase, therefore, was 49 members or 60 percent as compared with an increase of about 30 percent for the previous year. This increased membership is due to the activities of individual members of the Division coupled with the work of the Divisional membership committee which has accomplished much through circular letters and personal appeals, reaching all those interested in the industry.

The work of the Division has been made known to the industry by four circular letters, which have also been a valuable adjunct in interesting enamelers in the Society.

The Division held one special meeting during the year in conjunction with the Sheet Metal Ware Mfgs. Association at the Bureau of Standards, Washington, D. C., to consider the work of the Bureau on Fish Scaling. A committee of the Division has also co-operated in the application of these results to actual manufacture.

The efforts of the Program Committee of the Division has resulted in the preparation of a program of 16 papers for this meeting, the largest number ever presented at a gathering of this Society and highly gratifying in that all branches of the industry are represented.

All indications point to another year of increased growth and interest in this division.

Respectfully submitted,

R. R. DANIELSON, Sec.

Glass Division

This year has been one of great importance for the Glass Division and for the whole Society in that it has established a precedent in international co-operation. The invitation for the joint meeting extended last year to the British Society of Glass Technology was accepted by that Society and a delegation of 33 came to this country for the conference. A formal report of this meeting has been returned to Secretary Binns and has appeared in an abbreviated form in the Journal.

This joint meeting rather overshadowed the other activities of the Division and was probably the cause of a lessened activity in general Society affairs. For example the new membership of the Division has shown a comparatively small increase (17%) and over half of this is due to new foreign members. It is to be pointed out in this connection that new members cannot be secured by writing letters or by other efforts of a general nature and that only personal solicitation is effective. In addition to the voluminous correspondence the Secretary has sent six circular letters during the year to all members of the Division.

The condition of the treasury is as follows:

Receipts		Disbursements	
Balance from 1919..	$ 93.99	Disbursements for the year..	$158.29
Receipts for year...	128.25	Balance	63.95
	$222.24		$222.24

Respectfully submitted,

E. WARD TILLOTSON, Sec.

Refractories Division

There were no special meetings of the Division during the year, nor was there occasion for a great number of circular letters. The membership however, has increased from 100 to 124, and its activity may be best judged by its permanent record. Sixteen of the 76 original technical articles appearing in the Journal were on the subject of refractories and constituted 190 of the 740 printed pages. This is the equivalent of three complete issues. The Division lost the services of Mr. A. V. Bleininger as Chairman before his second term was completed, but was fortunate in securing Mr. A. F. Greaves-Walker for the remainder of the year.

Respectfully submitted,

R. M. HOWE, Secretary.

Terra Cotta Division

This division has finished its second year showing very satisfactory progress. We have fifty-seven members, all of whom are associated with the terra cotta industry.

We have ten papers and discussions for submission at this meeting on important subjects pertaining to the terra cotta industry.

By far the most important work now being carried on by the division is that which it is doing in conjunction with the National Terra Cotta Society. This society made quite a large

appropriation to be used for research work in co-operation with the Bureau of Standards and the Terra Cotta Division. The work is now well under way and we hope by the next meeting to have some important results for submission.

The financial standing of the division is as follows:

Cash in bank	$40.00
Credit with the secretary of the American Ceramic Society	39.50

Respectfully submitted,

R. L. CLARE, Secretary.

REPORTS OF LOCAL SECTIONS, 1920–1921

New York State Section

The New York State Section held one meeting during the year 1920. This meeting was held in December at Schenectady and those present were:

Edward Schramm, Onondaga Pottery Co., Syracuse
Mark Haley, Onondaga Pottery Co., Syracuse
J. B. Shaw, Alfred
E. E. F. Creighton, General Electric Co., Schenectady
L. E. Barringer, General Electric Co., Schenectady
F. Cermak, General Electric Co., Schenectady
Robert Twells, General Electric Co., Schenectady
C. C. Treischel, General Electric Co., Schenectady

At this meeting it was decided to give the New York State Section another chance for life and it was voted that each point of ceramic interest in the state should hold individual meetings. The Schenectady section held a meeting in the month of January at which twenty-five were present and much enthusiasm was evident. No other center held a meeting prior to February 1st, 1921.

Eastern Section

The summer meeting was held on June 25th, 1920, at the Trenton Country Club, Trenton, New Jersey. Attendance 80. The following very instructive papers were read:

"Superior Saggers"
C. F. Geiger, Carborundum Co.

"Recent Accomplishments in Ceramic Drying"
D. H. Applegate, Proctor & Schwartz, Inc.

"Studies on Clay in the Raw State"
A. V. Bleininger, Bureau of Standards

"The Selection of Refractories"
R. M. Howe, Mellon Institute

"Firing Wares in the Dressler Kilns"
Conrad Dressler

The annual meeting of the section will be held in March of this year.

The Executive Committee has held frequent meetings during the past year. The Eastern Section rendered material assistance in securing an appropriation of $100,000 for the erection of a new Ceramic Department at Rutgers College and has taken an active part in selecting plans for the building. Co-operating with the Eastern Section, the Eastern Terra Cotta Association has recently held a prize competition for an exterior design for the building. Fourteen designs were submitted in this competition and the plan selected for the building will conform closely with the prize-winning design.

The Section now has 190 members enrolled.

Report of the Chicago Section for 1920--1921

During the past year, four meetings were held with an average attendance of twenty-five at each session. As usual, a dinner or luncheon preceded the program. There are about one hundred and sixty-five names on our mailing list. Many of the persons so listed are located at points so far distant from

Chicago that regular or even occasional attendance at the meetings is scarcely to be expected. Of the total enrollment we estimate the active membership to be about sixty. In view of the fact that the active members are specialists and in the nature of things the papers offered are not of interest to all, but rather to certain groups, we therefore are of the opinion that the attendance has been fairly representative and satisfactory. However, it is our desire to make a better record during the ensuing year, especially with reference to stimulating more active participation on the part of those graduates of ceramic schools who are resident in our district.

The dates of the meetings and the programs presented were:

April 20—With the Illinois Clay Manufacturers' Association—

"Humidity Drying"
H. P. Matzen, Chicago

"The Enamel Brick Industry"
I. E. Hardy, Momence

May 21—

"The Enameling of Cast Iron"
L. H. Menne, Chicago

"The Preparation of Steel for Enameling"
L. G. Whitford, Chicago

November 27—

"Porcelain Enameling Furnaces"
C. G. Armstrong, Chicago

"Notes on Spark Plug Porcelain"
W. W. Wilkins, Chicago

"The Oil Gas Furnace in the Enamel Industry"
W. Rodehouse, Chicago

February 5, 1921—

"Notes on the Acid Resistance of Enameled Cooking Utensils" B. T. Sweeley, Chicago

"Notes on the Manufacture of Lead Products Used in the Ceramic Industry"
Lester T. Wilson, Chicago

The report of our activities would be incomplete without reference to the highly successful and very enjoyable summer session of the parent society which was held in Chicago. The very elaborate program was skillfully devised and most efficiently managed under the guidance of members of this section.

In closing we wish to express our regret on the removal of Mr. F. B. Ortman from this district. Mr. Ortman always gave freely of his services for the benefit of the section and he will be greatly missed. We wish him a full measure of success in his new connection.

New England Section

The New England Section has not been prosperous if you measure it by the attendance and number of meetings; but on the other hand, the meetings which are held are very interesting, as well as profitable. Those who do attend take a very active interest in the Section's affairs and the character of the papers and especially the interest in discussions have greatly improved over that of the first few meetings. The small attendance and infrequent meetings are due to the fact that Boston appears to be the most suitable place for meeting. It is the most easily reached of any city in the state, and accommodations can be there most readily arranged. On the other hand, nearly half the members reside in Worcester, but unfortunately Worcester meetings have not been highly satisfactory as regards attendance from outside.

On June 12, 1920, the seventh meeting of the Section was held at the Norton Boat Club in Worcester. In the afternoon an inspection was made of a private collection of old American pottery owned by Mr. Gates. In the evening with 18 members present an excellent paper was presented by Mr. Browne Harding on "Fuel Oil Burners for Tank Glass Furnaces."

The eighth meeting was held January 22, 1921, at the Engineers' Club in Boston. There were 13 members present, who were privileged to listen to four very interesting papers, as follows:

"Difficulties Encountered in the Manufacture of Watch Dials" F. P. Flagg

"Notes on the Efficiency of Clay Crucibles" H. W. Richter

"A Novel Testing Furnace" S. F. Walton

"Application of Pyrometers to the Ceramic Industries" H. Goldsen

At this meeting an election of officers took place as a result of which the following men were chosen to handle the affairs of the Section for the next year:

A. T. Malm, Chairman,
S. F. Walton, Secretary and Treasurer,
M. C. Booze, Councilor,
Browne Harding and Prof. C. L. Norton,
Members of the Executive Committee.

Northern Ohio Section

During the year the Northern Ohio Section has held four meetings, at Detroit, Sandusky and Cedar Point, Elyria, and Cleveland, respectively. The interest of the members has been manifested by a good attendance, presentation of technical papers, and the courtesy of various industries.

A. F. Gorton, B. A. Rice, Max Donauer, R. D. Landrum, and E. P. Poste have given technical papers, while the Jeffery-Dewitt Company, of Detroit, and the Elyria Enameled Products Company, of Elyria, have made the Section their guest, and other companies have aided in the success of the meetings.

There have been present men well known to many ceramic industries, who have favored the meetings with information, and at all times the Section has been made to feel the hearty co-operation of the parent Society.

Central Ohio Section

The Central Ohio Section held only two meetings during the year. The first was at Zanesville on November 12, 1920. The speaker was Professor A. S. Watts, who spoke on "The

Possibilities of a Terra Cotta Industry in Central Ohio." There were about thirty present. The second meeting was at Columbus on January 18, 1921. The speaker was Mr. Gerald Fitz-Gerald and his subject was "The Application of Heat." The Section closes its year with a treasury balance of $55.47.

The officers for the year are:

M. B. CHENEY, Chairman.
J. D. WHITMER, Secretary-Treasurer.
A. S. WATTS, Councilor.

Respectfully submitted,

ARTHUR S. WATTS, Councilor.

Pittsburgh District Section

The first meeting for the year of 1921 was held in the Chamber of Commerce Auditorium, Pittsburgh, Pa., on April 20, 1920.

The following program was presented:

"A Study of Spalling"
R. M. Howe, Mellon Institute

"Corrosion Tests for Glass Pot Mixtures"
D. H. Fuller, U. S. Bureau of Standards

"Pyrometric Practice"
Dr. Paul B. Foote, U. S. Bureau of Standards

A discussion of the last paper was led by Professor H. S. Hower of Carnegie Institute of Technology, which developed much interest.

At 6:30 P. M., April 20, a farewell dinner was given in the dining room of the Chamber of Commerce Building in honor of A. V. Bleininger, who was transferring his office of U. S. Bureau of Standards at Pittsburgh, Pa., to Washington, D. C.

Hearty tribute was paid to Mr. Bleininger as a man, a scientist and as a practical aid to the Ceramic industries of this district by the speakers.

Dr. Tillotson introduced the toastmaster, Francis W. Walker, Sr. Mr. Walker spoke of Mr. Bleininger as his friend, ever ready to give assistance.

L. E. Barringer of the General Electric Company spoke of Mr. Bleininger's college days and complimented him on his ever readiness to assist his classmates.

Mr. W. E. Wells of the Homer-Laughlin China Company mentioned the many ways in which Mr. Bleininger had aided the pottery industry of the United States.

Mr. W. L. Smith spoke in behalf of the United States Potters' Association.

The many members present felt the loss to the Ceramic industry as well as to the scientific circles of the Pittsburgh Section with Mr. Bleininger's transfer to Washington, D. C.

The second meeting of the year was held at Mellon Institute on December 21, 1920.

The following officers were elected for the coming year:

J. Spotts MacDowell, Chairman
Harbison-Walker Refractories Co.
A. V. Bleininger, Vice-chairman
Homer-Laughlin China Co.
J. W. Wright, Secretary
Macbeth-Evans Glass Co.
Thomas H. Sant, Treasurer
John Sant and Sons Co.
F. W. Walker, Jr. Councilor
Beaver Falls Art Tile Co.

A report submitted by the treasurer showed cash balance on hand December 21, 1920, $44.52.

The following program was presented:

"Properties of Commercial Gases"
F. J. Denk, Pittsburgh, Pa.
"The Use of the Microscope in Ceramics"
Dr. R. Thiessen,
U. S. Bureau of Mines, Pittsburgh, Pa.

The beginning of the year 1921 showed the Pittsburgh District Section to have 87 members in good standing.

REPORTS OF STUDENT BRANCHES, 1920--1921

Ohio State University Student Branch

The Student Branch held the following meetings during the past year:

On March 16, 1920, an address was given by E. P. Poste of Elyria, Ohio, on "Enamels and Enameling of Metals."

On April 13, 1920, H. G. Schurecht spoke on "The Effect of Size of Grain in Clay Bodies."

On May 11, 1920, the Annual Banquet was held, which on this occasion was at Marzetti's Restaurant. Toasts were responded to by each member of the senior class and also by Professors Demorest, McCaughey, Stull and Harrop.

The University year ended with all bills paid and a balance of $2.50 in the treasury.

On November 3, 1920, the first fall meeting was held and the following officers elected for the school year:

J. L. Carruthers, Chairman

D. M. McCann, Vice-chairman

Willard Stief, Secretary-Treasurer

Dr. L. I. Shaw of the U. S. Bureau of Mines talked on the "Activities of the Bureau."

On December 15, 1920, Mr. Wilbur Stout discussed "Fire Clay and Its Relation to Engineering Industries."

On January 19, 1921, Dean E. A. Hitchcock of the College of Engineering addressed the Branch on "The Engineer of the Future."

On February 15, 1921, Professor A. S. Watts spoke on "The Industrial and Art Possibilities of Metal Enamels.

There is a membership of forty-three, exclusive of faculty, and the meetings are uniformly well attended. The presence of students in the Department of Metallurgy is noted with pleasure. We also have enjoyed and profited greatly by the presence of members of the Bureau of Mines technical staff.

Respectfully submitted,

ARTHUR S. WATTS, Councilor.

New York State Student Branch

The New York State Student Branch has held bi-weekly meetings throughout the year. The following officers were elected at the first session to serve for one year:

David Robison, Chairman
Charles Stamm, Secretary-Treasurer

The programs were planned by the program committee with two ideas in view; first, to bring in speakers who are actually "on the job," in order to keep abreast of ceramic practice, and second, to encourage self-expression on the part of the students.

It was accordingly planned to have a formal talk by some authority on different phases of ceramic practice once a month and at the alternate meetings to have the upper classmen report on their Summer work in ceramic plants.

The monthly addresses so far given have been as follows:

"What the Manufacturer Expects of the Young Engineer" J. B. Shaw
"The Casting of Glass Pots"
Robert H. Sherwood, Bureau of Standards
"Remodeling a Face Brick Plant"
Howard Langworthy,
Jewettville Clay Products Company
"The Manufacture of Spark Plugs" Donald Hagar
Jeffery-Dewitt Co.

The Section plans a tour of inspection in the Spring to nearby ceramic plants. On account of the expense involved in a trip to Columbus, only three students were able to attend the annual meeting of the Society, but an enthusiastic meeting is anticipated when the Student branch meets with the Ceramic Guild (art students) for the annual banquet, when reports of the Convention are given. The Branch paid the expenses of one delegate to the Convention.

The membership is sixty and the average attendance at meetings has been forty-five.

Respectfully submitted,
G. A. BOLE, Councilor.

Iowa State College Student Branch

The Iowa State College Student Branch has held meetings twice a month on Wednesday evenings throughout the present college year.

At the first meeting J. W. Whittemore was re-elected President and L. R. Alt was elected Secretary and Treasurer. The following committees were appointed:

Program:

Mark Taylor
Fred W. Greenlee
L. R. Alt

Entertainment:

Harold Borg
Wayne Barrett
Robert Boyd

During the year Prof. Galpin delivered a talk on the manufacture of clay marbles, a particularly good talk. Prof. Cox told of the plans and methods of the grinding wheel plant in France with which he had been connected. J. W. Whittemore talked on the handling of a continuous kiln. Mark Taylor told of the method of manufacture of glass house tank blocks. Wayne Barrett told of tunnel kilns of the moving ware type, while the other meetings resolved themselves into general discussions of matters of more or less interest. One meeting was devoted to a Christmas tree and the cultivation of good fellowship, solely.

There is a healthy interest in the Branch on the part of the membership and it is especially pleasing to note that the underclassmen manifest the same interest as those with advanced knowledge of the work done in the field of ceramics in a practical way.

Respectfully submitted,

PAUL E. COX, Councilor.

University of Illinois Student Branch

The student branch started the year with only a small nucleus of upper-classmen to assume leadership in the activities of the society. A get-together smoker was held for the opening meeting in October which was well attended. Each one present was called upon to stand and introduce himself. The origin and purposes of the organization were explained and the relationship to the American Ceramic Society. Memberships were solicited with a fairly satisfactory response.

Four program meetings have been held during the first half of the present year at which either students or members of the faculty have spoken on subjects of interest but not entirely along the line of ceramics. A joint meeting, with the local student branch of the A. I. E. E., and a program on the subject of electrical porcelain, was planned for the January meeting but was postponed due to conflict in dates. This will be held in the near future.

The officers at the present time are:

Earl B. Baker, Chairman

Gordon Klein, Secretary-Treasurer

Respectfully submitted,

R. K. HURSH, Councilor.

REPORTS OF COMMITTEES, 1920–1921

Committee on Co-operation

1. Co-operation with the American Chemical Society.

The chairman of the Committee and one other representative met with a similar committee appointed by the president of the American Chemical Society to discuss the possibility of co-operation between the two societies. After discussion it was agreed that co-operation in the preparation and publication of ceramic abstracts could be entered into with

advantage to both societies. As a result of the report of this conference, the Council of the American Chemical Society authorized the editor of Chemical Abstracts to enter into a co-operative arrangement with the editor of the Journal of the American Ceramic Society in the preparation of ceramic abstracts. Such a co-operative arrangement has since been entered into by the two editors and is now in force.

2. Report of the Committee on Definition of the Term Ceramic.

In accordance with the action taken by the Society at its last meeting the Committee on Co-operation has assumed the duty of distributing copies of the Report of the Special Committee on "Definition of the Term 'Ceramic,' " and copies have been sent to the secretaries of the following societies:

The Society of Glass Technology
The Ceramic Society (English)
The Japanese Ceramic Society

The Syndicat des Fabricants de Produits Ceramiques de France. Acknowledgments have been received from the two English Societies.

The National Research Council has been requested by the Committee to secure through its foreign connections, a list of any other ceramic societies in the European countries.

Copies of the report were also sent to the editorial departmets of the following dictionaries and encyclopedias:

Encyclopedia Americana
Encyclopedia Britannica
New International Encyclopedia
American Year Book
Annual Register
Century Dictionary and Cyclopedia
New Standard Dictionary
Webster's New International Dictionary

3. Engineering Conference.

At the request of the Board of Trustees, the chairman of the Committee represented the Society at the organizing conference of the Engineering Societies held in Washington last

June. The chairman recommended that the Society join the new organization provided a feasible method could be found for financing its participation.

4. Ceramic Day at the Chemical Exposition

A creditable program was arranged and given on Ceramic Day, September 24, at the Sixth National Exposition of Chemical Industries. The program follows:

FRIDAY, SEPTEMBER 24TH

Under the Auspices of American Ceramic Society

12:30 P. M. Luncheon for members and guests, at Hotel Commodore, 42d St. and Lexington Ave.

2:30 P. M. Papers and discussion, Conference room
Opening Address—"The Potter's Art and the Chemist's Science"
Presented by R. H. Minton

"The Significance Attached to the Term Ceramic in Ancient and Modern Usage"

An abstract from the report of a committee of the American Ceramic Society
Presented by C. F. Binns

"A Classification of Sheet Steel Enamels" R. R. Danielson

"Refractories" H. F. Staley

"Ceramics and the People"
Charles F. Binns

"Decorative Architecture"
Leon V. Solon

"The Influence of the Artist in Industrial Ceramics"
J. Munro Hewlett

8:00 P. M. Moving Pictures, Conference Hall
"The Pottery Industry"
Courtesy of the Rookwood Pottery
"The Manufacture of Electrical Bulbs"
Courtesy of Nela Park Laboratories
Other Industrial Films

In this connection the Committee desires to express its appreciation of the work of Mr. Henry Schmidt, of the Roessler and Hasslacher Chemical Company, who acted as local representative of the Society and whose unfortunate death during the midst of the preparations for the Exposition it is our sad duty to record. The Committee is also grateful to Mr. George Hasslacher, of the Roessler and Hasslacher Chemical Company, for his helpfulness in taking charge of the local arrangements after the sudden death of Mr. Schmidt.

5. Use of Fuel Oil in the Ceramic Industries

A request from the American Gas Association for the collection of statistics concerning the consumption of fuel oil by the ceramic industries was referred to this Committee and after investigation the Committee recommended to the Board of Trustees that a suitable questionnaire be prepared and circulated to the membership of the various trade associations through the secretaries of these associations and that the replies to the questionnaire be transmitted to the American Ceramic Society's Committee on Research for tabulation, study and report.

6. Bibliography of Ceramic Books

In the August number of the Journal of Industrial and Engineering Chemistry there appeared a report of the American Chemical Society's Committee on the "Preparation of a Recommended List of Chemical Textbooks for Libraries." This report included certain recommendations with regard to books on ceramics. It seemed to the chairman of your Committee that these recommendations were most inadequate and misleading with reference to the nature and importance of the field of ceramics and the chairman therefore took the responsibility of addressing a letter of protest, in the name of the Society, to the editor of the Journal of Industrial and Engineering Chemistry, at the same time offering the services of the Committee on Co-operation in preparing a really representative list of ceramic books. This offer was accepted and such a list was prepared and published in the May number of the Journal of Industrial and Engineering Chemistry.

7. Recommendations

Your Committee has the following recommendations to make respecting the work of future Committees on Co-operation:

(1) It is recommended that the duty of arranging for Ceramic Day at the National Chemical Exposition be taken from the Committee on Co-operation and vested in a new committee appointed especially for this purpose, the chairman of which shall be a resident in or near the city in which the Exposition is held. It has been very difficult for the Committee on Co-operation during the last two years to satisfactorily look after this matter and the Committee is strongly of the opinion that it should no longer be considered a duty of this Committee.

(2) It is recommended that in the future the personnel of the Committee on Co-operation be selected so as to include one representative from each of the Divisions of the Society and that so far as possible the number of members on the Committee be limited to 10. At the present time there are 12 members and it seems to the Committee that this is an unnecessarily large number for the work which the Committee has to do, and it means that all communications between the chairman and the members of the Committee must be written twice in order to secure a sufficient number of clear copies. This extra labor seems unnecessary and should be avoided in the future. The correspondence of the Committee has involved the writing of something over a hundred letters during the year.

Respectfully submitted,
E. W. WASHBURN, Chairman.

Membership Committee

Your Committee on Membership begs leave to submit the following report for the year 1920:

As mentioned in last year's report, plans were already started with a view of adding a couple of Divisions to the Society and thus bring new interests into the organization.

With one of these Divisions in mind, Mr. Frederick H. Rhead was placed on the Committee and chiefly through his efforts has it been possible to advance as far as we have with the Ceramic Decorative Processes Division. We have every reason to believe this will be a success. If so, it will be the means of bringing in three hundred, or more, members.

Plans were also made for creating interest in a successful Heavy Clay Products Division, and a Division for those interested in cements, lime, mortar, etc. These plans have not developed as far as they should be. Plans for the Cement, Lime, and Mortar Division, however, have developed further than it would appear at present, and we may eventually expect a number of new members from this source.

So far, the development of the Heavy Clay Products Division has been discouraging. The field is enormous, and a great deal of missionary work has already been done for us, and we should at present have many more members interested in these products than we now have.

This failure is due, not only to the Membership Committee in neglecting to choose enthusiasts in this line, but chiefly on account of the lack of enthusiasm on the part of the officers and members of the old Brick and Tile Division. There is no reason why we should not have four or five hundred members interested in this work, provided we have made the activities of the Society such that the manufacturers could not afford to stay out.

The success of all our Divisions depends on this, and will depend on it more and more as the Society grows.

A few people join a Society because they are live wires and enthusiastic about anything in their line. A few join because they feel it is their duty. The majority, however, join for direct tangible benefit. Our Society is chiefly made up of of the first two classes, and we have reached our limit of growth unless we can interest the third class.

Two or three active Divisions are already interesting people of the third class, and will continue to grow. The peculiar thing about these Divisions is that, generally speaking,

they are not really as purely ceramic in their scope as are the less enthusiastic Divisions. The members of the Society in general, and the weaker Divisions in particular, must rise to the occasion if we are going to maintain the position in the Ceramic world that we should.

Two or three fields from which members can be secured should be mentioned at this time. Among these are the users of refractories. Some of these people have already shown considerable interest in the Society, but there are many more who should become interested. All the large power companies, steel mills, smelters, etc., are possible candidates and in most cases should be Corporation members.

A suggestion of one method of interesting these people would be a Hand Book on Refractories, compiled by the Refractories Division, and to be sold at a price sufficient to cover the expense of printing. This could be gotten up by the various experts in the Refractories Division, and would not only make interesting reading in the Journal, if part of the work was published each month, but by so doing could be prepared for distribution and sale as a Hand Book at a nominal price.

In view of the fact that the men who are most capable of writing a book of this sort are those most interested in the future market for refractories, it would mean not only increased benefit to the Ceramic Society, but also a direct benefit to the manufacturers.

The Standards Committees of the Divisions are also in a position to create interest in the Society by preparing standards for purchasers. This is particularly true of refractories, enameled iron, glass, and some type of porcelain.

Our Corporation membership is not what it should be. However, in increasing our membership, it must be borne in mind that Corporations are paying their yearly dues either because they think the Society is a good thing, and deserves encouragement and support, or else because they expect to derive some benefit from us, and want value received. We should go on the principle that all the members are of the

latter type, and we will not only sell ourselves to those who have to be sold to, but also give value received to those who are helping us.

The Division Chairmen can accomplish a great deal along this line by making it possible for the Divisions to be represented at gatherings, particularly of business men interested in their branches. For example, at meetings of the Refractories Association, The American Terra Cotta Society, The U. S. Potters' Association, The Tile Association, etc., there are nearly always members of the Ceramic Society present, but they do not go as members of the Society to boost for the Society. These are the places where a boost for the Society counts, and where we can really do good.

The Chairman's office has sent out the following correspondence during the year:

March—Form Letter	1300 letters
December—Form Letter	1350 letters
December—Resolution Card	1400 cards
February—Corporation Membership List	1400 letters
General—Personal Letter to each delinquent	142 letters
Total	5592

Besides this, there were a great many personal letters to various members of the Society, and prospects; also 600 letters sent out about February 13th, to various prospects for the Heavy Clay Products Division.

The fact that it was necessary to send out 142 personal letters to delinquent members as late in the year as August should furnish food for thought. Our records show that 42 acknowledged receipt of these letters, and I think Professor Binns also received some response.

This number of delinquents last year, together with the increase in dues for Associate members, and the general business condition this year, means that we must not only be sure we have something to sell prospective members this year, but work hard to sell it.

Professor Binns and Miss Binns deserve much credit for the assistance they have given the Membership Committee, and I wish to express my thanks to them.

It is difficult to estimate the amount of work done by the Membership Committee, or the Society as a whole. The one thing that will make a membership campaign a success is the belief on the part of each member of the Society that he is an important member of the Membership Committee, and that it is his duty to boost the interests of the Society, provided, of course, that he believes in it. It is the duty of the officers, and the various branches to make the Society such that the members can not help but believe in it.

The future is going to be largely dependent upon the Ceramic Society members and their ability to maintain such high standards in their various branches of the profession that no branch of the profession will feel that it can undertake research or development work without the advice and council of the Ceramic Society. The fact that we have members whose advice is sought is not enough. In this case the Society is strengthened by the members. To be a real success, and function properly, the Society must be such that the members, no matter who they may be, will be strengthened because they are members.

Our Committee on Research and Development should be so organized that it can go to various Associations that have problems of a ceramic nature, and show them how research work can be undertaken by them, and result in direct gain to the members of these Associations. Those to approach in cases of this sort should be the business heads and executives of large manufacturing concerns.

The appropriations and backing that Associations of this sort would give for the right sort of advice are such that the Ceramic Society could afford to permanently employ a full time consulting engineer of high calibre to act for it.

It is not altogether within the province of the Membership Committee to say what other standing Committees shall do, but the success of the Membership Committee's

efforts is going to be governed entirely upon what they have to sell to prospective members.

A membership campaign of any sort will be a failure if people join in a moment of enthusiasm, and later find they joined a Society because they thought it meant more to them than it really did. We must make our Society such that new members will find that the older they become, the more good they are deriving from their association.

The competition we are having from several Societies, each one of which is interested in at least one of the branches of the ceramic field, is such that we cannot afford to neglect the opportunity we have now, as it is only a question of time until others will have what we have already neglected too long.

If our Society can become so strong that it will be the only organization thought of when ceramic problems are mentioned, then we can feel that we are functioning as we should.

The Chairman of the Committee wishes to take this occasion to thank the members of the Committee for their work and co-operation; also, his Secretary, Miss Grace Wohlfelder.

Respectfully submitted,

F. H. RIDDLE, Chairman.

Committee on Papers and Programs

The work of this committee during the past year has been confined largely to arranging for the program of the annual meeting. The Divisional programs being in the hands of the Division secretaries this committee could plan only in a general way, and do what was necessary in assisting the various groups.

As the symposium on kilns last year proved of such great interest it was planned to have another session this year and to include one on the problems of saggers. It is believed that this plan should be followed each year in order to get information upon specific problems that are of general interest, and especially to bring out discussion.

In addition to the usual request sent to all members, many individual letters have been written in the work of building up a balanced program. The result has not been entirely satisfactory, and probably never will be, but evidence of the work accomplished is found in the program which is offered.

It is becoming increasingly difficult to get contributions along the line of new investigations and research work. This is due largely to the reduced output of our Federal Bureaus. Although private companies are doing more research work many are disinclined to publish the results.

In many ways it would seem that it would be better if our programs presented fewer papers and more discussion. By holding our meetings in smaller groups, which allows ample time, it is believed that there should be an endeavor to bring out more discussion of special problems. In this way there can be introduced a closer co-operation between the technical men and the practical men, and between them and the manufacturer.

In addition to our recommendations of previous years our chief recommendation to the succeeding committee is that they, soon after the annual meeting, send cards to all members asking that they indicate what work they will undertake during the year. By this means it will be possible for the chairman of this committee to keep in touch with the whole field, and to plan in such a way that the program of the annual meeting will represent a widely diversified list of contributions sure to be of interest and value to all members.

Your committee would further recommend that in the arrangement of the program all papers which seem to fall in more than one classification be included in the program of each division in which they might be of interest. It would be necessary that papers be so arranged as to time that they would not conflict. There has been considerable complaint that it is often not possible to hear certain papers because they appear only in one division and that members cannot always keep in touch with the various papers in which they are interested.

We would also suggest that the succeeding committee consider the advisability of including all papers of general interest in the general program. This may necessitate extending the meeting to five days so as to give an extra day to the general program.

Respectfully submitted,
R. H. MINTON, Chairman.

Committee on Publications

The receipts and expenditures for the year, together with those for preceding years, are given below:

Receipts

	Vol. I (1918)	Vol. II (1919)	Vol. III (1920)
From advertisers	$3,902.40	$4,678.24	$5,259.00
Bills receivable	.....	372.00	1,430.00
From non-member subscriptions	486.00	720.00	1,312.01
Total	$4,388.40	$5,770.24	$8,001.01

Disbursements

	Vol. I (1918)	Vol. II (1919)	Vol. III (1920)
Printing and distributing	$4,283.00	$5,737.23	$7,564.88
Abstracts	.....	358.90	569.77
Reprints	.....	431.45	461.80
Salaries (editor and assistant)	1,733.33	1,953.33	2,129.91
Editor's office expense	123.33	353.87	166.52
Total	$6,139.66	$8,834.78	$10,892.88
Excess of expenditures over Journal Revenue	$1,751.26	$3,064.54	$2.891.87

The Journal should be made self-supporting and the following steps were taken during the year to increase the revenue.

1. The rates for advertising were substantially increased, effective for new advertisers December 1, 1920, and applicable to all advertisers on June 1, 1921. The new rates established are shown in the following schedule.

ADVERTISING RATES

Space	*One Insertion*	*Three Insertions*	*Six Insertions*	*Twelve Insertions*
Eighth page	$ 9.75	$ 9.00	$ 8.25	$ 7.50
Quarter page	18.00	16.50	15.00	13.50
Half page	33.00	30.00	27.00	24.00
Full page	60.00	54.00	48.00	40.00

Preferred space: Back cover.....List plus 25%
Inside back cover.....List plus 20%
Opposite inside back cover.....List plus 20%
First page after reading.....List plus 20%

2. An agreement has been made with L. W. Allison, of Newark, N. J., to solicit advertising upon a commission basis.

3. The price of the Journal to non-member subscribers has been increased from $6.00 to $8.00 per year.

By these means it is hoped to bring the Journal revenue up to the desired point, that is, equal to or above the expenses of publication.

There has been ample subject matter for each number of the Journal and early difficulties in this direction have largely disappeared.

Regularity of issue has not yet been secured but improvement has been made and the Journal can be now counted upon to appear at least during the scheduled month.

The number of copies to be printed has been increased from 2200 to 2500 monthly.

Editor Staley found it necessary to resign towards the close of the year, having edited Volume III, and E. W. Washburn was appointed editor to take charge beginning with the January, 1921, number, (Vol. IV, No. 1).

Respectfully submitted,

L. E. BARRINGER, Chairman.

Committee on Rules

This Committee has had a number of important matters assigned to it during the past year and begs to report as follows concerning its activities:

During April, 1920, the modification of the Rules of the Society as regards Industrial Divisions was considered and recommendations submitted to the Board of Trustees.

During June, 1920, this Committee considered further changes in Rules governing Divisions and also changes in the Rule governing the Appointment of the Committee on Standards, and recommendations submitted to the Board of Trustees.

During July, 1920, this Committee considered the change of Rules governing Initiation Fees for Associates and Annual Dues for Active and Associate Members. Its recommendation was submitted to the Board of Trustees.

During October and November this Committee developed, with the aid of several other members of the Society, a set of By-Laws for the government of Technical Divisions of the Society and these were approved by the Board of Trustees in December, 1920.

This Committee has also been busy on a very extensive revision of the Rules of the Society, by which these will be changed to a Constitution and By-Laws.

This has consumed much time and is still undergoing modification but will be submitted to the Board of Trustees at this meeting.

Respectfully submitted,

ARTHUR S. WATTS, Chairman.

Committee on Sections and Divisions

The past year has witnessed a further extension of the scope of the internal as well as the external activities of the Society. Through the Student and Local Sections the work of the Society is being actively carried on by frequent meetings throughout the year in the larger ceramic centres, and the Industrial Divisions are providing a means for closer cooperation in the study of problems common to various groups of members engaged in the same branch of industry.

Owing to the lack of a definite rule on the subject, some of the Industrial Divisions were extending the privilege of membership in the Division to persons who were not members of

the parent society. It was the opinion of your committee that such procedure was not consistent with the aims and objects which it had in view in the formation of Divisions and felt that the word "Divisions" should be construed as the term used to designate a classified group of the society in contrast to a separate and distinct organization within the society designated by the term "Section." All non-members who were allowed to retain their membership in the Division through a special ruling designated to prevent antagonism should be urged to become members of the society so that the organization of the Division can proceed strictly according to the recently adopted rules of the society pertaining thereto.

A proposal was received to form a Division which would embrace those members who were directly interested or engaged in the artistic and decorative branches of the Ceramic Industry. After a survey of the number of members who would actively participate in such a Division it seemed that there was sufficient enthusiasm to warrant the formation of a "Division on Ceramic Decorative Processes." The temporary organization of this group has already been completed and the permanent organization should be effected at this meeting. We believe that the name which this Division is now designated by is far too cumbersome and at the same time not wholly descriptive of the branches of industry embraced.

During the past year all of the Divisions with the possible exception of the Whitewares and Brick and Tile have been functioning properly and making as rapid progress as could be expected in the short time they have been in existence. There is still much to be done to strengthen the position and broaden the scope of activities of all the Industrial Divisions and with the reorganization of the two previously mentioned Divisions it is to be hoped that the coming year will see each carrying its share of the work of the society.

Most of the Local Sections are holding regular meetings at stated intervals and are a credit to the Society. However, there are one or two Sections which exist in name only. This is due chiefly to the fact that although the number of persons interested is larger than in some other sections, the territory

embraced in the Sections is so large that it is impossible to hold a meeting at any point which can be reached by an even moderate amount of travel on the part of those interested.

We would recommend that due consideration be given to the abolishment of the present Sections on geographical lines and the re-establishment of Local Sections in cities or small areas of intensive ceramic activity. Furthermore we believe that the initiative for the formation of the Sections should emanate from those who will eventually become the members of such a Section and that Sections be established only after a careful survey of the number of active members of a locality who are willing to pledge their services to the upbuilding and continuation of such a Section.

The potential possibilities of future development and extension of the activities of the Society through its Sections and Divisions are very great and should not be lost sight of by the incoming committee.

Respectfully submitted,

S. C. LINBARGER, Chairman.

Summer Meeting, 1920

The 1920 annual Summer Meeting was held in Chicago, August 16, 17 and 18. Headquarters were established at the Hotel La Salle, and a total of 113 members registered. This established a new record for attendance at Summer Meetings.

On Monday the party visited the plant of the Bach Brick Company, where the use of the Penfield setter and the combination fuel oil-steam system of burning common brick proved highly interesting. Later in the afternoon the plant of the Northwestern Terra Cotta Company was visited. Here the Dressler Tunnel Kiln, completed and ready for operation and the new humidity dryers, successfully operating, held the special attention of the party for the remainder of the day.

In the evening, through the generous aid of the local manufacturers, a complimentary dinner was tendered the visit-

ing members at Hotel LaSalle. The dinner was followed by a short business session after which "Dean" W. D. Gates became Master of Ceremonies and conducted that office in his usual interesting style. R. H. Minton, President, who had just returned from an extensive trip abroad, gave us a highly interesting talk on industrial and political conditions in Germany. One or two other short informal talks and a few vaudeville stunts completed the evening's entertainment.

On Tuesday morning the party visited the plants of the Lindsay Light Company, manufacturers of gas mantels, and the Coonley Manufacturing Company, makers of enameled cooking utensils. Leaving the latter plant at noon the party was taken to the plant of the Western Electric Company, where a most excellent complimentary luncheon was served. The entire afternoon was spent witnessing the various operations employed in the manufacture of equipment used in the telephone and telegraph industry.

The final day of the meeting started with a pleasant ride on a special train on the North Shore Electric R. R., through the beautiful north shore suburbs of Chicago, passing Ft. Sheridan and the Great Lakes Naval Training Station to Waukegan and North Chicago. The first plant visited here was that of the American Steel & Wire Company, where the rolling and drawing of 6" billets into wire and the subsequent manufacture of springs, fencing, etc., was watched with great interest. We then visited the plant of the Chicago Hardware Foundry Company, manufacturers of porcelain enamel ware, and were again tendered a complimentary luncheon by this company.

This closed the formal part of the program. However, several of the members stopped off at Ravinia Park for an enjoyable evening of Grand Opera.

The sustained interest on the part of visiting members and cheerful adherence to the program as mapped out, made the work of the Local Committee a real pleasure.

Respectfully submitted,

F. B. ORTMAN, Chairman.

Committee on Standards

The work accomplished during the past year by this Committee has not been large in volume because it has been concerned largely with the details of putting methods into final form for publication. During the first six months of the period the whole membership was especially active. The later slacking off in the Committee's activity was due almost entirely to the fact that the Chairman was not able to give to the work the increased amount of time that became necessary.

At present we have nearly completed the work outlined as in progress in our last year's report. The membership of the Society by letter ballot have adopted as standard the methods for Drying shrinkage, Shrinkage and Pore Water, Water of Plasticity, True Specific Gravity, Softening Point, and Behavior in Firing. It was gratifying to the Committee that in every case where a negative ballot passed, the member took the time to present his reasons for so doing. The tentative and optional methods have been completed and there remains to be done only the final arrangement of the appendix in order to have all this work ready for the printer.

It would be advisable to have this in print at as early a date as possible for the very limited editions to the two former bulletins have become exhausted and continued requests are still being made for them. In this connection, we would recommend that you give some thought to the advisability of making a nominal charge in the future to cover the cost of printing and distributing the report of this Committee. Almost invariably those requesting copies inquire as to the price. This policy has already been adopted with respect to the report of the Committee on Ceramic Raw Materials. Considering the fact that the Society's income from dues is hardly sufficient to meet operating costs, a nominal charge for special publications would seem entirely in order.

As mentioned last year the Committee has considered a change in the rule governing the appointment and functions of the Committee on Standards so that it may better represent the varied activities of the Society and serve also to correlate

any standardization work done within the several divisions, this resulting in our presenting to the Board and the Committee on Rules a revision of the rule pertaining to the appointment and duties of the Committee on Standards. This was later submitted by the Committee on Rules through the Board to the membership and was accepted by letter ballot.

The Committee for 1921 will be appointed on this basis and it is expected that this new arrangement will make possible more thorough and efficient work on standardization of methods than has been possible in the past.

Respectfully submitted,

M. F. BEECHER, Chairman.

Committee on Ceramic Research

(Joint Committee with the National Research Council)

The committee held two meetings during the year 1920, both at Washington, D. C. At the meeting held in May the appointment of a research fellow at the Corning Glass Works, Corning, N. Y., on the subject of the viscosity of glasses at elevated temperatures was reported to the council at large and approved. This work is being done at the University of Illinois. Plans were also discussed at the first meeting for the promotion of technical research in the ceramic industry. It was proposed to approach the glass and clay pot industry on the subject of an investigation dealing with the subject of American clays and the compounding of mixtures, suitable for resisting the attack of the more corrosive glasses. It was further proposed to approach the pottery industries in connection with an investigation, having for its purpose the correlation of the thermal expansion of the bodies and glazes with their compositions. Both of these projects were communicated to the industries concerned, but so far with negative results. A general study of the properties of clays was discussed, but the industries chiefly concerned have not yet been approached, though it is felt that a general investigation of the physical properties of clays is urgently needed. Although

considerable work has been done in connection with this broad topic no systematic correlation has been attempted and no serious effort has as yet been made to study the characteristics of clays from the more exact physical standpoint.

During the summer the subject of a co-operative investigation relating to the structural clay products was discussed with Mr. E. R. Sturtevant at his invitation. The feasibility of conducting such a project was pointed out at this conference and the desirability of bringing together the various heavy clay products interests shown. This matter was in abeyance until a meeting was held in Cleveland on Dec. 20th, 1920, attended by the secretaries of the Hollow Building Tile, the Common Brick, Face Brick, and Paving Brick Associations. At this meeting a possible organization for purposes of co-operative research was discussed and the secretaries agreed to submit the matter to their organizations. This was done and another meeting was held in Chicago on Feb. 15th, at which committees, appointed by five trade associations, were present. At this meeting it was proposed to submit to the associations concerned a plan of raising a fund of $10,000 for the year 1921 and at least as much for the year 1922. The proposed co-operative research is to be directed by an executive committee, composed of the chairmen of the several constituent committees. The committee is to select a permanent chairman and to elect a permanent secretary and such other officers as may be required. In addition a technical committee is to be created which is to have charge under the executive committee of the actual prosecution of the research work. The writer was chosen as chairman of the technical committee with power to appoint such other members as may be required for the conduct of the work. The chairman requested the Bureau of Standards and the Bureau of Mines to take representation on this committee and asked that the chairman of the Heavy Clay Products Division of the A. C. S. become a member of the committee, ex officio. In addition Dr. E. W. Washburn of the University of Illinois was asked to serve. It is the intention to appoint additional members of the technical staff as the work is brought on the way.

The plan as outlined is to be submitted to the several associations for final approval and a meeting of the executive committee is to be held as soon as a research program has been worked out by the technical committee. A permanent organization will then be formed and the program submitted passed upon.

The members of the technical committee, composed of representatives of the Federal Bureaus and the Research Council, met at the convention of the A. C. S. in Columbus, O., and outlined a tentative program embracing subjects related to the burning of clay products. This outline is to be enlarged and worked out in detail for discussion and approval at a subsequent meeting.

Respectfully submitted,

A. V. BLEININGER, Chairman.

PUBLICATIONS OF THE AMERICAN CERAMIC SOCIETY

Annual Transactions			Bound in Cloth
Vol. I.	1899	110 pages	$4.75
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A complete set of the Transactions, minus Vols. IX, XII, and XIX which are out of print, may be purchased at..... $150.00

(Second-hand copies of Vols. V, IX, and XIX, are sometimes available. Orders for these should be filed with the Secretary.)

To members of the Society a reduction of 40% will be made from the above prices. Members cannot purchase more than one copy of each volume at members' rate.

The Society has also published the following books, which will be sold net, at the prices listed, to the public and members alike:

The Collected Writings of Dr. Hermann August Seger, Volume I, (a) Treatises of a general scientific nature. (b) Essays relating to Brick and Terra Cotta, Earthenware and Stoneware, and Refractory Wares. 552 pages. Bound in cloth.....$7.50

The Collected Writings of Dr. Hermann August Seger, Volume II. (a) Essays on White Ware and Porcelain. (b) Travels, Letters and Polemics. (c) Uncompleted works and extracts from the archives of the Royal Factory. 605 pages. Bound in cloth $7.50

A Bibliography of Clays and the Ceramic Arts, by Dr. John C. Branner, 1906. 451 pages. Bound in cloth. Contains 6027 titles of works on Ceramic subjects..... $2.00

Collective Index to the Transactions of the American Ceramic Society, compiled by E. J. Crane..... $1.50

The above publications can be obtained of the Secretary and will be shipped at the consignee's expense by express or parcels post to any address on receipt of the price. To all who purchase a complete set of the Transactions, a copy of the Branner Bibliography is given free. Make all checks or money orders payable to The American Ceramic Society.

CHARLES F. BINNS, Secretary,
Alfred, N. Y.

Libraries Where Publications of the American Ceramic Society May be Found

Boston Public Library, Boston, Mass.
Carnegie Library, Pittsburgh, Pa.
Carnegie Free Library of Allegheny, Pittsburgh, Pa.
Cincinnati Public Library, Cincinnati, Ohio.
Cleveland Public Library, Cleveland, Ohio
Columbia University Library, New York City.
Cornell University Library, Ithaca, N. Y.
John Crerar Library, Chicago, Ill.
Detroit Public Library, Detroit, Mich.
Free Library, Philadelphia, Pa.

Grosvenor Public Library, Buffalo, N. Y.
Hall of the Franklin Institute, Philadelphia, Pa.
Iowa State College Library, Ames, Iowa.
Johns Hopkins University Library, Baltimore, Md.
Library of Congress, Washington, D. C.
Los Angeles Public Library, Los Angeles, Cal.
Massachusetts Institute of Technology, Boston, Mass.
Missouri School of Mines, Rolla, Mo.
New Jersey Ceramic Research Station, New Brunswick, N. J.
Newark Free Public Library, Newark, N. J.
New York Public Library, New York City.
New York State Library, Albany, N. Y.
New York State School of Ceramics, Alfred, N. Y.
Ohio State University, Columbus, Ohio.
Princeton University Library, Princeton, N. J.
Providence Public Library, Providence, R. I.
Purdue University Library, LaFayette, Ind.
Spokane Public Library, Spokane, Wash.
Syracuse Public Library, Syracuse, N. Y.
St. Louis Mercantile Library, St. Louis, Mo.
St. Louis Public Library, St. Louis, Mo.
Trenton Free Public Library, Trenton, N. J.
United States Patent Office, Washington, D. C.
University of California, Berkeley, Cal.
University of Colorado, Boulder, Colo.
University of Illinois, Urbana, Ill.
University of Iowa, Iowa City, Iowa.
University of Michigan, Ann Arbor, Mich.
University of Minnesota, Minneapolis, Minn.
University of Texas, Austin, Texas.
University of Utah, Salt Lake City, Utah.
University of Washington, Seattle, Wash.
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Worcester Free Public Library, Worcester, Mass.

FOREIGN

Brunswick Technical School, Brunswick, Australia.
Bureau of Science, Manila, P. I.
Chemical Society, London, England.
Library, Pall Mall, Hanley, England.
McGill University Library, Montreal, Canada.
Mudie's Select Library, London, England.
New South Wales Public Library, Sydney, Australia.
Tohoku Imperial University Library, Sendai, Japan.
University of Toronto Library, Toronto, Canada.
Victoria Library, Melbourne, Australia.

CONSTITUTION AND BY-LAWS

CONSTITUTION

ARTICLE I

(1) This Society shall be known as the American Ceramic Society.

(2) The object of the Society is to advance the ceramic arts and sciences by meetings for the reading and discussion of papers, the publication of scientific literature, and other activities.

ARTICLE II

Membership

(1) The Society shall consist of Honorary, Active, Associate, and Corporation Members.

(2) Honorary Members must be persons of professional eminence, elected in recognition of their achievements in ceramic art or science. Their number shall not exceed ten.

(3) An Honorary Member shall be nominated by at least ten Active Members and unanimously approved by the Board of Trustees. Their nomination shall be placed before the Society at an annual meeting, and to be elected they must receive the affirmative vote of at least ninety per cent of those voting, by letter ballot, at the next succeeding annual election.

(4) Active Members must be persons competent to fill responsible positions in ceramics. Only Associate Members shall be eligible to election as Active Members and such election shall occur only in recognition of attainments or of services in the science, technology, or art of the ceramic or allied industries.

(5) The Board of Trustees shall at each regular meeting advance to Active Membership all Associate Members whose activity in the Society or whose prominence in the ceramic industries, in the opinion of a majority of the Board of Trustees, merits such recognition. Any Active Member may nominate in writing Associates for Active Membership, accompanying same by a written statement of the qualifications of each candidate, and the Board of Trustees shall act on such recommendations at the next regular meeting of the Society.

(6) Associate Members must be persons interested in the ceramic or allied industries.

(7) Corporation Members must be persons, firms, or corporations who, being interested in the Society, make such financial contributions for its support as are prescribed in Article III. Their membership shall become operative on payment of dues as prescribed in Article III.

(8) All Honorary Members, Active Members, Associate Members, and Corporation Members shall be equally entitled to the privileges of membership, except that only Active Members and one representative of each Corporation Member shall be entitled to vote. Such representative shall be officially designated by the person, firm, or corporation represented. Only Active Members shall be entitled to hold office. The roster of each grade of membership shall be printed separately in at least one publication issued by the Society annually.

(9) Any person may be expelled from any grade of the membership of the Society if charges signed by five or more Active Members be filed against him or her, and if the Board of Trustees examine into and sustain said charges by a majority vote. Such person, however, shall be first notified of the charges against him and be given a reasonable time to appear before the Board of Trustees or to present a written defense, before final action is taken.

ARTICLE III

Dues

(1) Honorary Members shall be exempt from all fees and dues.

(2) The annual dues for Active and Associate Members shall be fixed by the Board of Trustees but shall not exceed ten dollars, six dollars of which shall be a subscription to the **Journal of the American Ceramic Society.**

(3) Corporation Members shall pay such annual dues as are fixed by the Board of Trustees but these shall not be less than twenty-five dollars, six dollars of which shall be a subscription to the **Journal of the American Ceramic Society.** The privileges of membership shall begin upon payment of the annual dues.

ARTICLE IV

Officers

(1) The affairs of the Society shall be managed by a Board of Trustees consisting of the President, the Vice-President, the Treasurer, the retiring President, his immediate predecessor, and three Trustees. The President, the Vice-President, and the Treas-

urer shall be elected to serve one year. The Trustees shall be elected to serve three years, one Trustee being elected each year.

(2) The President shall have general supervision of the affairs of the Society under the direction of the Board of Trustees and shall perform such other duties as pertain to his office.

(3) He shall countersign the checks drawn by the Treasurer when such drafts are known by him to be proper and duly authorized by the Board of Trustees.

(4) A Secretary shall be appointed by the Board of Trustees for a term of not more than 2 years.

(5) The Secretary shall see that all moneys due the Society are carefully collected and transferred to the custody of the Treasurer. He shall carefully scrutinize all expenditures and use his best endeavors to secure economy in the administration of the Society. He shall personally investigate and certify the accuracy of all bills or vouchers on which money is to be paid. He shall have charge of the books of accounts of the Society and shall furnish monthly to the Board of Trustees a statement of monthly balances. He shall present annually to the Board of Trustees a balance sheet of his books as of the 31st of December and shall furnish from time to time such other statements as may be required of him.

(6) He shall conduct the correspondence of the Society and keep full record of the same. He shall transmit promptly to the Board of Trustees for their consideration all communications not of routine nature. He shall cause to be published in the Journal the results of all balloting on the business of the Society unless otherwise ordered by the Board of Trustees. He shall perform all other duties which may from time to time be assigned to him by the Board of Trustees.

(7) The Secretary may be paid a salary to be determined by the Board of Trustees.

(8) The Secretary shall furnish a suitable bond for the satisfactory performance of his duties, which shall be held in the custody of the President.

(9) The Treasurer shall receive all moneys due the Society and deposit the same in the name of the Society in a National Bank designated by the Treasurer and approved by the Board of Trustees. He shall invest all funds not needed for current disbursements, as shall be ordered by the Board of Trustees. He shall pay all bills by draft, when certified by the Secretary or as ordered by the Board of Trustees. He shall furnish a satisfactory

bond for the proper performance of his duties, which shall be held in the custody of the President.

(10) All securities belonging to the Society shall be held in the custody of the Treasurer.

(11) The accounts of the Secretary and of the Treasurer shall be audited before each annual meeting by a certified public accountant or some other competent person designated by the Board of Trustees.

(12) A vacancy in any office shall be filled by appointment by the Board of Trustees but the new incumbent shall not thereby be rendered ineligible for re-election to the same office at the next annual meeting. On the failure of any officer or any member of a committee to execute his duties within a reasonable time, the Board of Trustees, after duly warning such person, may declare the office vacant and appoint a new incumbent.

(13) A majority of the Board of Trustees shall constitute a quorum, but the Board of Trustees shall be permitted to carry on such business as they may desire by letter.

ARTICLE V

Elections

The nominating committee shall be composed of the last two ex-presidents and one representative elected by each Division and Local Section who shall select a ticket for the offices of President, Vice-President, Treasurer, and one Trustee. The Secretary of the Society shall be chairman (without vote.) At least ninety days before the annual meeting the Secretary shall send the names of the nominees to each voting member. Any ten members, at least five of whom shall be Active, may constitute a self-appointed nominating committee and present the names of any nominees to the Secretary, provided this is done at least thirty days before the annual meeting. The names of all nominees, provided their assent has been obtained before nomination, shall be placed upon the ballot in alphabetical order and shall be mailed to each voting member, not in arrears, at least twenty days before the annual meeting. The voting shall be confined to the names appearing on this ballot. The ballot shall be enclosed in an envelope on which there shall be no mark of identification other than the word "Ballot." This envelope shall be enclosed in another envelope for mailing, addressed to the Secretary, upon the back of which the voter shall endorse his name. The envelopes and ballots shall be opened in the presence of three scrutineers appointed by the President, who will report the result of the election at the last session of the annual meeting. A plurality of affirmative votes cast shall elect.

ARTICLE VI

Standing Committees

(1) The following Standing Committees shall be appointed annually by the Board of Trustees:

1. Rules
2. Publications
3. Membership
4. Standards
5. Sections and Divisions
6. Papers and Programs
7. Co-operation
8. Research and Development

The chairman of each committee shall be appointed by the Board of Trustees.

(2) The Committee on Rules shall consist of five members in addition to the chairmen of the Rules Committees of the divisions having such committees. It shall receive all recommendations relating to changes of Constitution and By-Laws and shall report upon the same to the Secretary for transmission to the Society. It shall have power to propose changes in the Rules of the Society.

(3) The Committee on Publications shall consist of the Editor and four members. The duties of the Editor and Committee on Publications are defined under Article X on Publications.

(4) The Committee on Membership shall consist of at least five members in addition to the chairmen of Membership Committees of the divisions having such committees, and shall have power to appoint sub-committees. Its function shall be to undertake systematically the enlargement of the membership of the Society amongst those interested in the ceramic and allied industries.

(5) The Committee on Standards shall consist of at least five members in addition to the chairmen of the Standardization Committees of the Divisions having such committees, and it shall have power to appoint sub-committees.

(6) The divisional Standardization Committees shall be appointed in and by their respective divisions. Their function shall be the preparation of tests and specifications for the materials and products of their respective branches of the ceramic industry. Each shall be responsible to its own division, but all reports, resolutions, or recommendations that are to be printed or generally distributed shall be approved by the Committee on Standards before publication.

(7) The function of the Committee on Standards shall be to prepare or have prepared tests and specifications for ceramic materials and products and to submit to the Board of Trustees written reports, resolutions, and recommendations relating thereto. The Committee may report at any regular meeting of the Society. For adoption, these reports, resolutions, and recommendations must be submitted in printed form to the members of the Society at least six months before a vote may be taken, during which time any amendments, changes, or corrections, suggested by any member may, with the approval of the Committee, be incorporated. The reports, resolutions, and recommendations as amended shall then be submitted by letter ballot to the voting members. A two-thirds vote shall be required for adoption, and the polls shall close 60 days after distribution of the ballot.

(8) The Committee on Sections and Divisions shall consist of five members in addition to the chairmen of the Divisions. Its duties shall be to promote the organization and welfare of Local Sections, Student Branches, and Divisions.

(9) The Committee on Papers and Programs shall consist of the secretaries of the Divisions, the Secretary of the Society, and such other persons as the Board of Trustees may deem advisable. Its duties shall be to procure papers and discussions for the meetings and publications of the Society. The Committee may require an abstract of any paper submitted before placing it upon a program.

(10) The Committee on Co-operation shall consist of five members in addition to the chairmen of the Co-operation Committees of the Divisions having such committees.

(11) The Committee on Research and Development shall consist of five members in addition to the chairmen of the Research and Development Committees of the divisions having such committees. Its duties shall be to organize and encourage scientific investigations pertaining to the ceramic and related industries, especially those investigations which will stimulate the development of our national industries and resources. It shall be empowered to co-operate with similar committees of other scientific societies and with Government bureaus.

ARTICLE VII

Divisions

(1) Groups to be known as Divisions of the Society and to be organized from members of the Society may be authorized by the Board of Trustees for stimulating the growth and development of the Society, when such action shall seem wise and expedient. Only

bona fide members of the Society are entitled to affiliate with and participate in the activities of such Divisions, but Divisions which, prior to August, 1920, have enrolled persons who are not members of the Society, may retain such persons as members of the Division. A member of the Society may enroll in any Division in which he is interested.

(2) The affairs of a Division shall be managed by a Chairman, a Secretary-Treasurer, and such other officers as the division may deem necessary. The officers of the Division shall be elected annually by ballot at the last session of the Division held during the annual meeting of the Society and shall take office at the close of the meeting at which they are elected. All members of a Division are entitled to vote. The officers shall hold office for one year or until their successors are elected.

ARTICLE VIII

Local Sections

(1) Local Sections, each carrying some distinguishing title prefixed to the words "Section of the American Ceramic Society," may be authorized by the Society.

(2) The purposes of such sections shall be to strengthen and extend the work of the Society, as defined in Section I of its Rules, by more frequent meetings in local centers than are possible to the Society as a whole, and by bringing the benefits of the work to persons who would not otherwise be reached.

(3) Application for permission to form a Local Section must be in writing and signed by not less than ten members of the Society in good standing, residing in the general locality where the Section is to be formed, of whom one at least shall be an Active Member. To be considered at any given meeting an application must be filed with the Secretary at least thirty days prior to the date of the meeting and notice that the application is pending must appear in the program of the meeting. To be granted, the application must receive the affirmative vote of two-thirds of those present. In event of affirmative action the Society will issue a charter to the applicants, authorizing them to form a Section under the name proposed. Charters for Local Sections may be temporarily suspended by the Board of Trustees for cause, but no charter can be permanently rescinded except by vote of two-thirds of those present at a regular meeting of the Society, after due publication in the program of the meeting that the matter is pending.

(4) Local Sections shall have power to make their own rules and by-laws except that they shall not pass any rule or by-law which is in conflict with the Rules of the Society.

(5) The officers of Local Sections shall be a Chairman, a Secretary, a Councilor, and such others as the Sections may prescribe. The duties of the Chairman and Secretary shall be such as usually pertain to those offices. The Councilor shall be an Active Member of the Society. He shall be elected by the Local Section and it shall be his duty to advise the Section in all matters pertaining to its relations with the Society and to make an annual report to the Society regarding the work and status of the Section. The names of the Chairman, Secretary, and Councilor of each Section shall appear in the roster of the Society.

ARTICLE IX

Student Branches

(1) Student Branches, each carrying some distinguishing title prefixed to the words "Student Branch of the American Ceramic Society," may be established in institutions in which regular courses of instruction in ceramics are maintained.

(2) The purpose of such Student Branches shall be to strengthen and extend the work of the Society, as defined in Section I of the Rules, by enlisting the interest and support of students in ceramics while still in school and by stimulating the spirit of ceramic research among them.

(3) Application to form a Student Branch in any institution must be in writing, signed by not less than five regularly enrolled students in good standing and endorsed by two or more members of the Society. The application must be filed and acted upon as provided for Local Sections in Section IX, and may be suspended or revoked for cause in the same manner.

(4) Student Branches shall have power to make their own rules and by-laws, except that they shall not pass any rule or by-law in conflict with the Rules of the Society.

(5) The officers of Student Branches shall be a Chairman, a Secretary, a Councilor, and such others as the Student Branch may prescribe. The Chairman and Secretary shall be elected by the Student Branch and their duties shall be such as usually pertain to those offices. The Councilor shall be an Active Member of the Society, appointed by the Board of Trustees to act in this capacity to the Student Branch. The duties of the Councilor shall be to advise the Student Branch in all matters pertaining to its relations to the Society and to make an annual report to the Society regarding the work and status of the Student Branch. The names of the Chairman, Secretary, and Councilor of each Student Branch shall appear in the roster of the Society.

ARTICLE X

Publications

(1) The Board of Trustees may employ, at a suitable compensation, an editor of the publications of the Society.

(2) The Committee on Publications shall have general supervision of the publications of the Society and of contracts and expenditures connected therewith, subject to the approval of the Board of Trustees.

(3) In the consideration of papers offered for presentation or publication those papers containing matter readily found elsewhere, those specially advocating personal interests, those carelessly prepared or controverting established facts, and those purely speculative or foreign to the purpose of the Society shall be rejected. The Committee on Publications shall determine which papers shall be printed. The Committee may return a paper to the writer for correction and emendation and may call to its aid one or more members of special experience relating to the subject treated, either to advise on the paper or to discuss it.

(4) All papers and discussions presented before the general session of the Society shall become the property of the Society and their publication or other disposition shall be in the hands of the Committee on Publications.

No paper or discussion presented before a Division or Local Section shall be offered for publication elsewhere until the Committee on Publications shall have had the option of accepting the same for use in the **Journal of the American Ceramic Society.**

(5) The Committee on Publications shall provide for the publication of a monthly periodical entitled the **Journal of the American Ceramic Society,** the subscription price of which shall be six dollars to members and eight dollars to non-members.

(6) One copy of each issue of the paper-bound edition of the Journal shall be sent prepaid to each member of the Society not in arrears. No member shall be furnished with more than one copy of each issue free for any single year. A member may be permitted to complete by purchase one file of the publications of the Society at less than the current commercial rate, the amount to be fixed by the Board of Trustees and to be called the member's rate.

(7) The Secretary shall have the custody of all publications of the Society, shall keep them safely stored and insured, and shall sell them to the public at prices which shall be fixed by the Board of Trustees. The Board of Trustees shall also, from time to time, fix the price of the volumes remaining unsold and shall have authority to refuse to sell the back volumes of the Transactions and

Journals except in complete sets, at such time as the quantity remaining of any number becomes so small as in their judgment to warrant such action.

(8) The Editor shall request the author of each article appearing in the Journal of the Society to fill out and sign, within a definite time limit, a form, specifying the number of reprints of said article, if any, which he desires. This form shall contain a table from which can be computed the approximate cost at which any reprints will be furnished. In event that the expense of furnishing the desired number of reprints is large, the Board of Trustees may require the author to pay part or all of the cost involved before the publication of the reprints is begun. On receipt of such signed order within the time limit set the Editor shall cause to have printed the desired number of copies. If the author makes no reply or replies after the time limit has expired then the Society will not be responsible for the publication of any reprints of the article in question except at the usual market price for the printing of new matter.

(9) No one shall have the right to demand the publication of an article independent of the discussion which accompanied it and no one having taken part in a discussion upon an article shall be entitled to order reprints of the discussion separately and apart from the article itself.

(10) The Society is not, as a body, responsible for the statement of facts or opinions expressed by individuals in its publications.

ARTICLE XI

Parliamentary Standard

Roberts' "Rules of Order" shall be the parliamentary standard on all points not covered by these rules.

ARTICLE XII

Amendments

Any proposed amendment to this Constitution must be presented in writing at a regular meeting of the Society and, if approved by the Committee on Rules or by any ten Active Members, must be printed on a ballot and sent out not earlier than thirty nor later than sixty days after the adjournment of the meeting at which the amendment was presented. If the said letter ballot shows an affirmative vote of not less than two-thirds of the total vote cast within fourteen days of the date of mailing, then the same shall be declared carried and shall at once become effective.

ARTICLE XIII
By-Laws

The Society shall make such By-Laws not in conflict with this Constitution as may be necessary for the proper government of the Society. Such By-Laws shall become operative when approved by the Board of Trustees and confirmed by a two-thirds affirmative vote of the members voting at any annual meeting.

BY-LAWS

SECTION I
Meetings

(1) The annual meeting shall take place on the first Monday in February, or as soon thereafter as can be arranged, at such place as the Board of Trustees may decide, at which time reports shall be made by the Board of Trustees, Treasurer, and scrutineers of election, and the accounts of the Treasurer shall be audited by a committee of three appointed by the President. Twenty-five Active Members shall constitute a quorum at any regular meeting and a majority shall rule unless otherwise specified.

(2) Other meetings may be held at such times and places during the year as the Board of Trustees may decide, but at least twenty days notice shall be given of any meeting.

(3) The President shall appoint at the annual meeting a committee of five, to be known as the Summer Meeting Committee, whose duty it shall be to arrange for a summer excursion meeting at some suitable point. They shall then select a local committee which shall have charge of the details of the meeting. The expenses of the Summer Meeting Committee in arranging the program of visits and for printing, rooms, and facilities for meetings shall be borne by the Society.

SECTION II

(1) At the Annual Meeting of the Society, the order of business shall be as follows:

1. President's address.
2. Reading of minutes of last meeting.
3. Reports of the Board of Trustees and Treasurer.
4. Old business.
5. New business.
6. Reading of papers.
7. Announcement of election of officers. Honorary and Active Members.
8. Installation of officers.
9. Appointment of committees.
10. Adjournment.

SECTION III

Only Active Members shall be eligible to election as officers.

SECTION IV

Any members in arrears for over one year may be suspended from membership by the Board of Trustees until such arrears are paid. Active Members in arrears are not eligible to vote. The annual dues of Active and Associate Members are payable on January first.

SECTION V

The Secretary of each Division, Local Section, and Student Branch shall report to the Secretary of the Society the names of its officers and Standing Committee Chairmen within three weeks of their election or appointment and shall also furnish the Secretary with a complete list of its membership on April 1st of each year.

SECTION VI

(1) Any person interested in the ceramic and allied industries is eligible to membership in a Local Section.

(2) Local Sections shall have power to fix their own dues or assessments, such dues or assessments being in addition to and independent of the regular dues and assessments of the Society upon its members. No Section shall have authority to incur debt in the name of the Society or for which the Society may become liable.

SECTION VII

(1) Membership in a Student Branch shall be limited to the instructional force and regularly enrolled students of schools in which branches are located, subject to the rules of the school concerned governing outside activities of students.

(2) Student Branches shall have power to fix their own dues and assessments and, as such, shall pay no dues to the Society. No Student Branch shall have authority to incur debt in the name of the Society or for which the Society may become liable.

(3) Members of a Student Branch as such shall pay no dues to the Society but upon depositing a certificate of good standing from their Secretary, may purchase from the Society its publications at the same rate as Associate Members of the Society. This privilege shall cease when the student's connection with the school ceases, but members of a Student Branch, upon leaving school, may at once become Associate Members of the Society by depositing their certificates, making proper application, and paying the regular dues.

SECTION VII

(1) The Committee on Publications shall acknowledge to the author acceptance of all contributions submitted to it and in case of rejected contributions the original copy shall be returned to the author.

(2) Contributions remaining in possession of the Committee on Publications for more than one year without publication shall cease to be the property of the Society and shall revert to the author.

SECTION VIII

The Board of Trustees shall have power to make any rules not inconsistent with the Constitution and By-Laws for the conduct of its business.

IN MEMORIAM

Robert T. Hall

Jacob Hasslacher

W. G. Hipp

J. M. McClave

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†**Agge, Franklin**, Buffalo, N. Y., Manager of Works, Republic Metalware Co.

Ahlswede, R. B., 1406 N. Spring St., Los Angeles, Cal., Secretary, California Metal Enameling Co.

Ahrens, Robert S., St. Paul, Minn., Seeger Refrigerator Co.

†**Albery, D. F.**, 2525 Clybourn Ave., Chicago, Ill., Northwestern Terra Cotta Co.

Algeo, A. M., Washington, Pa., Superintendent, Hazel Factory No. 1, Hazel-Atlas Glass Co.

Allcock, Francis T., 449 S. Malabar St., Huntington Park, Los Angeles, Cal., American Encaustic Tiling Co.

†**Allison, LeRoy W.**, 170 Roseville Ave., Newark, N. J., Advertising Manager, "Journal of the American Ceramic Society."

Amsler, Walter O., D. Sc., 707 Farmers Bank Bldg., Pittsburgh, Pa., President, Amsler-Morton Co.

Anderson, Geo. O., Parkersburg, W. Va., Secretary and Treasurer, General Porcelain Co.

Anderson, John A., 299 Central St., Gardner, Mass., Electrician and Chemist, Central Gas and Oil Stove Co.

Anderson, Robert E., 402 W. Boylston St., Worcester, Mass., Norton Co.

Anthony, Wm. R., Taunton, Mass., Foreman, Enameling Department, Weir Stove Co.

Arbenz, Fred J. A., Cambridge, O., Manager, Florentine Pottery.

Arbogast, F. J., Fairmont, W. Va., Keystone Chemical Co.

Ashman, Alfred O., 277 Delaware Ave., Palmerton, Pa., Research Division, New Jersey Zinc Co.

Auld, F. Howard, Columbus, O., General Manager, The D. L. Auld Co.

Austin, Arthur Oswin, 326 N. 6th St., Barberton, O., Factory Manager, Ohio Insulator Co.

Austin, G. L., Joliet, Ill., Superintendent, American Refractories Co.

Austin, James L., 42 Sterling Rd., Waltham, Mass.

Axford, Vincent, Kenova, W. Va., Jeffery-Dewitt Insulator Co.

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Ayer, Kenneth R., (address unknown)

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Bachman, P. S., 92 West Maynard Ave., Columbus, O., Student, Ohio State University.

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† Elevated to Active Membership, February, 1921.

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Baggs, Arthur E., Marblehead, Mass., Manager, Marblehead Pottery Co.

Bailar, John C., 1512 Maple St., Golden, Col., Assistant Professor of Chemistry, Colorado School of Mines.

Baker, G. V., (address unknown)

†**Bardush, J. F.**, Grand Rapids, Mich., Grand Rapids Refrigerator Co.

Barker, Charles E., Matawan, N. J., Atlantic Tile Manufacturing Co.

Barlow, Alfred, Wilmington, Del., Superintendent, Golding Sons Co.

†**Barnes, T. R.**, Mansfield, O., Secretary and General Manager, Barnes Manufacturing Co.

Bartells, H. H., 426 Westminster Ave., Los Angeles, Cal.

Barth, Victor, 128 Bridge St., Great Barrington, Mass., Enameler, Stanley Insulating Co.

Bartlett, E. E., Sapulpa, Okla., Bartlett-Collins Glass Co.

Bartlett, John H., Jr., 366-368 Gerard Ave., New York City, The Surface Combustion Co.

Bassett, Leon B., Winchendon, Mass., Assistant Sales Manager, Baxter D. Whitney & Son, Inc.

Bates, Charles E., 542 East Grove St., Galesburg, Ill.

Bauer, James L., Middletown, Conn., Assistant Secretary and Assistant Treasurer, New England Enameling Co.

Bausch, Frederic E., 1105 Chemical Bldg., St. Louis, Mo., Proprietor, Fire Clay Mines.

Bautz, Robert A., Murphysboro, Ill., Isco-Bautz Co., Inc.

Beasley, H. C., Cicero, Ill., General Superintendent, Coonley Mfg Co.

Becket, Frederick M., Niagara Falls, N. Y., Chief Metallurgist, Union Carbide Co.

Becque, Lieut. J. H., Edgewood, Md., Edgewood Arsenal.

Bedson, William, Lawrence Road, Trenton, N. J., Assistant Manager, Elite Pottery Co.

Beeken, L. L., Kenova, W. Va., Jeffery-Dewitt Insulator Co.

Behrent, Leo A., 1515 Lumber Exchange Bldg., Chicago, Ill., Laboratory Assistant, Midland Terra Cotta Co.

Bell, Fred S., 1318 Wright Bldg., St. Louis, Mo., Vice President. Mandle Clay Mining Co.

Benner, Wm. J., Grand Ledge, Mich., Briggs-Michigan Clay Co.

Berger, Wm. S., 1601 Woodburn Ave., Covington, Ky., Secretary, Cambridge Tile Mfg Co.

Bergmans, Carl, Flint, Mich., Champion Ignition Co.

Berkey, Paul L., 309 Wabash Bldg., Pittsburgh, Pa., Secretary-Treasurer, Lava Crucible Co.

Best, Harold A., (address unknown)

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†Elevated to Active Membership, February, 1921.

Betteley, Albert G., 27 Richton Ave., Detroit, Mich., Superintendent. Process Laboratory, Jeffery-Dewitt Co.

Bickel, Earl A., Postville, Iowa, Assistant to Manager, Postville Clay Products Co.

Bissell, G. F., Ottawa, Ill., Superintendent, Chicago Retort and Fire Brick Co.

Bitting, A. W., 3344 Michigan Ave., Chicago, Ill., Director of Research, Glass Container Association of America.

Blachford, H. L., (address unknown)

Blackburn, C. A., Cleveland, O., General Superintendent, "Ivanhoe Plant," Cleveland Metal Products Co.

Blair, J. A., Kushequa, Pa., Superintendent, Kushequa Brick Co.

Blake, Alfred E., 1150 Greenfield Ave., Squirrel Hill District, Pittsburgh, Pa.

Blodgett, Malcolm, Woburn, Mass., Superintendent, R. Guastavino Co.

Bloomfield, Howard, Metuchen, N. J., Secretary-Treasurer, New Jersey Clay Products Co.

Bloxsom, John J., Brookville, Pa., Superintendent, Brookville Glass & Tile Co.

Blum, John W., New Straitsville, O., The Straitsville Impervious Brick Co.

Blumenthal, Geo., Jr., 143 Industrial Bldg., Washington, D. C., U. S. Bureau of Standards.

Bonner, James M., Jr., Robinson, Ill., Assistant Manager, Zwermann Co.

†**Booraem, J. Francis,** 52 Vanderbilt Ave., New York City, Treasurer and Manager, American Enameled Brick and Tile Co.

Borg, H. E., 1601-6th St., Perry, Iowa.

Borkey, J. H., Land Title Bldg., Philadelphia, Pa., District Sales Agent, Elk Fire Brick Co.

Boudreau, James C., 725 Fulton Bldg., Pittsburgh, Pa., Board of Education, Director of Art Education.

Bour, Laurence J., Box 285, Scranton, Pa., President, L. J. Bour Refractories Co.

Bowne, Edward, Cloverport, Ky., Murray Roofing Tile Co.

Boyden, Mrs. E. S., Southbridge, Mass., Librarian, American Optical Co.

Bracken, Lloyd, 770 Coleman Ave., Clarksburg, W. Va., Furnace Foreman.

Bradshaw, A. R., (address unknown)

Bragdon, William V., 2336 San Pablo Ave., Berkeley, Cal., "The Tile Shop."

Brain, George, New Castle, Pa., Manager, Universal Sanitary Manufacturing Co.

Bramlett, Mrs. Julian T., R. F. D. No. 1, Enid, Miss., General Manager, Bramlett Clay Property.

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†Elevated to Active Membership, February, 1921.

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Brann, Albert, Ph. D., 220 Springdale Ave., East Orange, N. J., Research Chemist, Westinghouse Lamp Co., Bloomfield, N. J.

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Brenholtz, W. K., Flint, Mich., Foreman, Clay Preparation Department, Champion Ignition Co.

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Brett, R. C., 331 S. Main St., Washington, Pa., Hazel-Atlas Glass Co.

Brian, Charles, Easton, Pa., General Manager, Clay Department, Paper Makers Chemical Co.

Brian, George, East Liverpool, O., Salesman, Paper Makers Chemical Co.

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Briggs, Leonard S., 46 Yard Ave., Trenton, N. J., Lenox, Inc.

Brinkman, S. G., Fords, N. J., Proprietor, Clay Mines and Fire Brick Works.

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Brooks, Charles T., 8205 Euclid Ave., Cleveland, O., Treasurer, Summit China Co., Akron, O., Treasurer, Iroquois China Co., Syracuse, N. Y.

Brower, Fred W., Uhrichsville, O., Belden Brick Co.

Brown, Byron P., Belvidere, Ill., Vice-President and General Manager, The Hercules Porcelain Co.

†**Brown, Davis,** Bucyrus, O., Hadfield-Penfield Steel Co.

Brown, Edmund, 510 W. Front St., Perrysburg, O.

Brown, Lawrence H., East Liverpool, O., The R. Thomas & Sons Co.

†**Brown, Leslie,** Trenton, N. J., Lenox, Inc.

Brown, L. K., Zanesville, O., Vice-President, The Burton Townsend Co.

Brown, Richard P., Wayne Junction, Philadelphia, Pa., President, Brown Instrument Co.

†**Brown, Wilbur F.,** Charleston, W. Va., The Libbey-Owens Sheet Glass Co.

Browning, T. S., (address unknown)

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†Elevated to Active Membership, February, 1921.

Brownlee, Wm. L., Toledo, O., Foreman, Clay Department, Buckeye Clay Pot Co.

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Buck, W. E., Granite City, Ill., Metallurgist, National Enameling and Stamping Co.

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†**Buckner, O. S.,** 44 Wellington St., Worcester, Mass., Norton Co.

Burchfiel, B. M., Alberhill, Cal., Loh Angeles Pressed Brick Co.

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Burgess, M. L., Indianapolis, Ind., Secretary-Treasurer, Marietta Mfg Co.

Burt, F. M., Massillon, O., American Stamping and Enameling Co.

Burton, Chas. G., Peru, Ind., Manager, Peru Electric Co.

Burton, R. C., Zanesville, O., President, Burton-Townsend Co.

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Cable, Margaret K., Grand Forks, N. Dak., Instructor in Ceramics, University of North Dakota.

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Callaghan, J. P., (address unknown).

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Cameron, A. C., North East, Md., Manager, North East Fire Brick Co.

Cameron, C. V., Box V, Richmond, Cal., Superintendent, Pacific Sanitary Mfg Co.

Carhart, C. C., Sheffield, Iowa.

Carling, J. P., Zanesville, O., China Products Co.

Carman, C. F., Berkeley Springs, W. Va., President, National Silica Works.

Carrier, Augustus, Detroit, Mich., Chemist, Detroit Dental Mfg Co.

Carter, B. F., 565 Linn St., Peoria, Ill., Peoria Brick and Tile Co.

†**Carter, C. E.,** 119 Bridge St., Peoria, Ill., General Manager, Carter Brick Co.

Caruthers, Raymond G., Blandburg, Pa., Assistant to Superintendent, Production Department, Harbison-Walker Refractories Co.

Case, W. W., Jr., Denver Athletic Club, Denver, Colo., Treasurer, Lalley Western Electric Co.

Casey, Charles L., Cambridge, O., President, Guernsey Earthenware Co.

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†Elevated to Active Membership, February, 1921.

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Clark, Horace H., 325 Peoples Gas Bldg., Chicago, Ill., Fuel Engineer.

Clark, John, 292 Lockwood St., Astoria, N. Y., Superintendent, New York Architectural Terra Cotta Co.

Clayter, Frederic C., Pittsburgh, Pa., Art Department, University of Pittsburgh.

Coates, Wm. W., Jr., 304 Indiana St., Lawrence, Kan., Lawrence Tile Co.

Coe, John H., 547 Rosedale St., Wilkinsburg, Pa., Vesuvius Crucible Co

Colburn, Ed. D., 2801 Hereford St., St. Louis, Mo. Superintendent, Blackmer & Post Pipe Co.

Cole, M. J., Logan, O., Superintendent and Treasurer, The Logan Clay Products Co.

Collin, Louis, Alfred, N. Y.

Cook, John H., Minerva, O., The Owen China Co.

Cooke, May E., Columbus, Ohio.

Cooper, Geo. W., Room 608, 19 Liberty St., New York City, Publisher, "The Glass Industry."

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Cox, Harold N., 48 Woodland Ave., Glen Ridge, N. J.

Cox, S. Frank, Creighton, Pa., Pittsburgh Glass Co.

Coxon, J. B., Kokomo, Ind., Assistant Superintendent, Standard Sanitary Manufacturing Co.

Coxon, J. Frederick, Fredricksburg, O., President, Wooster Sanitary Manufacturing Co.

Cramer, W. E., 213 East South St., Fostoria, O.

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Cunningham, M. F., Waltham, Mass., Superior Corundum Wheel Co.

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Cutting, J. W., (address unknown)

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†**Dains, I. F.**, Monmouth, Ill., President and General Manager, Western Stoneware Co.

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Dana, Leslie, St. Louis, Mo., President, Charter Oak Stove and Range Co.

Darlington, Homer T., Box 736, Natrona, Pa., Metallurgical Engineer, Pennsylvania Salt Manufacturing Co.

Davies, J. L., Clayton, Wash., Superintendent, Washington Brick, Lime, and S. P. Co.

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† Elevated to Active Membership, February, 1921.

Davis, Harry E., Chicago, Ill., Northwestern Terra Cotta Co.

Davis, S. E. 929 Division St., South Parkersburg, W. Va., General Porcelain Co.

Day, O. L., 1513 Kirby Bldg., Cleveland, O., Harbison-Walker Refractories Co.

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Dennis, J. Alfred, Trenton, N. J., Superintendent, Golding Sons Co.

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†**DeWitt, Bert G.**, New Philadelphia, O., Superintendent, Belmont Stamping and Enameling Co.

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Earl, Oliver N., Box 97, E. Liverpool, O., Harshaw, Fuller & Goodwin Co.

Early, Joseph W., Dickson City, Pa., Superintendent, Early Foundry Co.

Edson, S. P., Bryantville, Mass., Superintendent and Enameler, Wheeler Reflector Co.

Edwards, W. L., Tiltonsville, O., Assistant Superintendent, Wheeling Sanitary Mfg Co.

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† Elevated to Active Membership, February, 1921.

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Emminger, Thos. F., Pittsburgh, Pa., General Superintendent, Pittsburgh Clay Pot Co.

Emrick, W. A., Derry, Pa., Assistant to General Superintendent, Pittsburgh High Voltage Insulator Co.

Engle, C. C., Toms River, N. J., Assistant Manager, Crossley Mining Co.

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Evans, A. W., Zanesville, O.

Evatt, Franks G., 350 Madison Ave., New York City, Vice-President, Atlantic Terra Cotta Co.

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Fenton, Harry W., 1419 Lowell Ave., Lima, O.

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†**Fettke, Charles R.**, Pittsburgh, Pa., Carnegie Institute of Technology.

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Fitzpatrick, John, 533 10th St., Niagara Falls, N. Y., Carborundum Co.

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Foersterling, Hans, Ph. D., The Abor Farm, Jamesburg, N. J.

†**Foltz, Andrew**, 187 North Union St., Lambertville, N. J., President, Lambertville Pottery Co.

†**Footitt, F. Farnsworth**, Hoboken, N. J. American Lead Pencil Co.

Ford, G. Bergen, Candler Bldg., Atlanta, Ga., B. Mifflin Hood Brick Co.

Forester, Herbert, Box 37, Cleveland, O., Principal, Veritas Firing System Co.

Forman, L. P., Arnold, Pa., American Window Glass Co.

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† Elevated to Active Membership, February, 1921.

†**Forst, Daniel P.**, 216 West State St., Trenton, N. J., Factory Manager, Robertson Art Tile Co.

Forsyth, J. H., Cleveland, O., Associate Chemist, Glass Technology Department, National Lamp Works of G. E. Co.

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Foster, Harry D., 266 Industrial Bldg., Washington, D. C., U. S. Bureau of Standards.

Fowler, Wm. E., Paxtonville, Pa., Paxton Brick Co.

Francais, Paul P., Box 46, Frankfort, Ind., Superintendent, Ingram-Richardson Mfg Co.

Frantz, Samuel G., Crossett, Ark., Engineer, By-Products Development, Crossett Lumber Co.

Franzheim, C. Merts, Wheeling, W. Va., The Chas. M. Franzheim Co.

Frazier, C. E., Washington, Pa., President, Simplex Engineering Co.

Frey, Wm. J., 304 W. Adams St., Sandusky, O., Superintendent, Universal Clay Products Co.

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†**Fritz, E. H.**, Box 510, Derry Pa., Ceramic Engineer, Westinghouse Electric and Mfg Co.

†**Fuller, Donald H.**, Washington, D. C., Ceramic Assistant, U. S. Bureau of Standards.

Fuller, J. R., 22 Highland Ave., Salem, Mass., Hygrade Lamp Co.

Fuller, Ralph L., 720 Electric Bldg., Cleveland, O., Harshaw, Fuller & Goodwin Co.

Galloway, Walter B., Philadelphia, Pa., President, Galloway Terra Cotta Co.

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Gehrig, Edward F., Detroit, Mich., Research Engineer, Detroit Stove Works.

Geiger, Carl F., 427 Valley St., Dayton, O., Valley Engineering Co.

†**Geisinger, E. E.**, Rochester, N. Y., The Pfaudler Co.

†**Geller, Roman F.**, Washington, D. C., U. S. Bureau of Standards.

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†Elevated to Active Membership, February, 1921.

George, J. S., 135 Rebecca St., Kittanning, Pa., Bureau of Standards, Pittsburgh, Pa.

George, W. C., 286 Alice St., E. Palestine, O., Vice-President, W. S. George Pottery Co.

Gernon, Ursula T., Brookings, S. D., Craft Instructor, South Dakota State College.

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Gilmore, R. B., E. Liberty Branch, Y. M. C. A., Pittsburgh, Pa., Ceramic Engineer, Vesuvius Crucible Co.

†**Gleason, Marshall W.,** 864 Park Place, Brooklyn, N. Y., President and General Manager, Gleason-Tiebout Glass Co.

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Goodner, Ernest F., Spokane, Wash., Washington Brick, Lime and Sewer Pipe Co.

Goodwin, Herbert, New Cumberland, W. Va., Chelsea China Co.

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†**Grafton, Charles O.,** Muncie, Ind., Treasurer and General Manager, Gill Clay Pot Co.

Grafton, C. V., Muncie, Ind., Treasurer and General Manager, Muncie Clay Products Co.

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Grant, W. Henry, St. Marys, Pa., Elk Fire Brick Co.

Gray, Arthur E., Pittsburgh, Pa., Treasurer and General Manager, Pittsburgh Clay Pot Co.

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†Elevated to Active Membership, February, 1921.

Gray, John R., 4311 Scovel Place, Detroit, Mich., Jeffery-Dewitt Co.

Greene, R. W., Mayfield, Ky., Kentucky Construction and Improvement Co.

Greenough, Maurice B., 830 Engineers Bldg., Cleveland, O., Secretary, National Paving Brick Manufacturers Association.

Greenwood, G. W., Dunbar, Pa.

Greenwood, John L., (address unknown)

Gregori, Andrew, 16th St. and 54th Ave., Cicero, Ill., Midland Terra Cotta Co.

Gregori, John N., Chicago, Ill., Kiln Burner, Northwestern Terra Cotta Co.

Gregorius, Thomas K., Corning, N. Y., Ceramic Engineer, Corning Glass Works.

Gregory, M. C., Corning, N. Y., Ceramic Engineer, Brick, Terra Cotta and Tile Works.

Griffith, R. E., 670 Bullitt Bldg., Philadelphia, Pa., Manager, Refractories Sales, E. J. Lavino & Co.

†**Guastavino, Rafael, Jr.**, Fuller Bldg., Broadway and 23d St., New York City, President, R. Guastavino Co.

Guenther, Emil B., 351 S. Negley Ave., Pittsburgh, Pa., Harbison-Walker Refractories Co.

Gunther, Franklin W., Magnolia, O., Superintendent, National Fire Proofing Co.

Guthrie, Chester, Hillsboro, Ill., Pottery Foreman, Eagle-Picher Lead Co.

Guthrie, Lee, Elyria, O., Foreman, Elyria Enameled Products Co.

Haberstroh, Herbert N., 53 West Jackson Blvd., Chicago, Ill., Sales Engineer, Celite Products Co.

Haeger, E. H., Dundee, Ill., President, The Haeger Potteries, Inc.

Hager, Donald, 955 Brighton Blvd., Zanesville, O., Mosaic Tile Co.

Hahn, Carl A., 2138 Blendon Place, St. Louis, Mo., Assistant Engineer, Parker-Russell Mining and Manufacturing Co.

Hail, Walter, 2801 Hereford St., St. Louis, Mo., Kiln Burner, Blackmer & Post Pipe Co.

Hall, Herman A., Vanport, Pa., McLain Fire Brick Co.

Hall, William C., 1302 3d National Bank Bldg., Atlanta, Ga., Vice-President, Atlanta Terra Cotta Co.

Hamilton, James, Trenton, N. J., Superintendent, Ideal Pottery of the Trenton Potteries.

Hammer, John M., Box 555, Pittsburgh, Pa., Managing Editor, "China Glass and Lamps."

Handke, Paul A., 260 S. Academy St., Galesburg, Ill., Assistant Superintendent, Purington Paving Brick Co.

Hanna, Harold H., Crystal City, Mo., Pittsburgh Plate Glass Co.

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† Elevated to Active Membership, February, 1921.

Hansen, J. E., Pittsburgh, Pa., Industrial Fellow, Mellon Institute.
Hardesty, B. D., Beaver Falls, Pa., The Mayer China Co.
Harding, Browne, 586 Atwells Ave., Providence, R. I., Experimental Engineer, Providence Base Works of General Electric Co.
Harding, C. Knox, 6318 Stoney Island Blvd., Chicago, Ill., Consulting Engineer.
Hare, Robert L., Upper Sandusky, O., Manager, Wyandot Clay Products Co.
Harker, O. A., Jr., Puryear, Tenn., President and Manager, Dixie Brick and Tile Co.
Harper, John L., Niagara Falls, N. Y., Hydraulic Power Co.
Harrell, E. R., Checotah, Okla., Superintendent, Graham Glass Co.
Harris, Marshall W., 227 East Park Place, Oklahoma City, Okla., Student, University of Illinois.
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†**Harvey, F. A.**, Mt. Union, Pa., U. S. Refractories Corp.
Harvey, Ives L., Bellefonte, Pa.
Harvey, J. Ellis, Orviston, Pa., General Manager, Centre Brick and Clay Co.
Hasslacher, Geo. F., Box 360, Cleveland, O., The Roessler & Hasslacher Chemical Co.
Hawke, C. E., Niagara Falls, N. Y., Sales Manager, Refractories Dept., Carborundum Co.
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Healey, A. S., Elizabeth, N. J., Superintendent, Standard Sanitary Pottery Co.
Heath, Fred T., 4505 18th Ave., N. E., Seattle, Wash.
Heistand, Elza F., Muncie, Ind., Superintendent, Crucible Department, Gill Clay Pot Co.
Heiser, P. D., Flint, Mich., Ceramic Engineer, Champion Ignition Co.
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Henry, Kenneth M., San Francisco, Cal., Illinois Pacific Glass Co.
Henshaw, S. B., Charleston, W. Va., Assistant General Manager, Libbey-Owens Sheet Glass Co.
Hepler, I. F., 207 First National Bank Bldg., Tyrone, Pa., Chief Engineer, General Refractories Co.
†**Hepplewhite, J. W.**, Pittsburgh, Pa., The Koppers Co., Mellon Institute.
Herbst, Abram W., Canaan, Conn., New England Slab Co.
Herrell, Carson, Kokomo, Ind., Secretary and Treasurer, Kokomo Sanitary Pottery Co.

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†Elevated to Active Membership, February, 1921.

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Heuisler, Philip I., Baltimore Md., President, Maryland Glass Corp.

Hewitt, L. C., 4928-A Itaska St., St. Louis, Mo., Chief Dispatcher, Laclede-Christy Clay Products Co.

Hibbins, Thomas A., Wellsville, O., General Business and Sales Manager, The Stevenson Co.

Hibbs, Jos. S., 3203 West Columbia Ave., Philadelphia, Pa., Assistant General Manager, J. W. Paxson Co.

Hill, Charles W., Perth Amboy, N. J., General Works Manager, Atlantic Terra Cotta Co.

Hill, Jas. H., 604-608 Pacific Electric Bldg., Los Angeles, Cal., President, Alberhill Clay and Coal Co.

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Hodges, R. T., 303 Railway Exchange Bldg., Chicago, Ill., Magnus Co.

Hoehl, Joseph W., Box 367, Piqua, O., Manager, Enameling Department, Favorite Stove and Range Co.

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Hollingsworth, C. M., Steubenville, O., Ohio Valley Clay Co.

Hollmeyer, John G., 4226 Hazel Ave., Edgewater Sta., Chicago, Ill., Secretary and Treasurer, American China Co.

Holmes, J. C., Sandusky, O., Superintendent, Sandusky Bulb Works.

Holmes, M. E., Ph. D., 918 G St., N. W., Washington, D. C., Manager, Chemical Department, National Lime Association.

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† Elevated to Active Membership, February, 1921.

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Hunt, Frank S., Beaver Falls, Pa., Beaver Falls Art Tile Co.

Hunt, Marsden H., 374 Avenue E, East Pittsburgh, Pa.

Ichijo, Mokyi, New York City, care T. H. Ohyama, Woolworth Bldg.

Inman, G. E., Nela Park, Cleveland, O., Development Engineer, Lamp Development Laboratory.

Irwin, Dewitt, East Liverpool, O., Secretary, Potters Supply Co.

Jackson, H. W., DuBois, Pa,. General Manager, Jackson China Co.

Jacquart, Chas. E., South River, N. J., American Enameled Brick Co.

†**Jaeger, Frank G.**, 10th and Mullanphy Sts., St. Louis, Mo., Vice-President and General Manager, Superior Enamel Products Co.

James, W. Roy, 118 W. 14th St., Marion, Ind., Bethevan Factory, Macbeth-Evans Glass Co.

Jenks, H. P., 614-615 Commerce Bldg., Cor. High and Spring Sts., Columbus, O., Hook Patent Kiln Co.

Jennings, Anthony J., St. Louis, Mo., Superintendent, Buck's Stove and Range Co.

Jensen, James L., 156 Greene St., Brooklyn, N. Y., Assistant Manager, Empire China Works.

Jewett, Fred E., Muncie, Ind., General Superintendent, Ball Brothers Glass Manufacturing Co.

Jewett, Richmond, Lackawanna, N. Y., Superintendent, Jewett Refrigerator Co.

Johnson, A. A. V., 1137 W. 78th St., Chicago, Ill., L. E. Rodgers Engineering Co.

Johnston, Robert M., Kenova, W. Va., Ceramic Engineer, Jeffrey-Dewitt Insulator Co.

Jones, Benjamin C., Pittsfield, Mass., Porcelain Works of General Electric Co.

Jones, Cecil, Maurer, N. J., American Encaustic Tiling Co.

†**Jones, Chester H.**, 1570 Old Colony Bldg., Chicago, Ill., Industrial Editor, "Chemical and Metallurgical Engineering."

Jones, Otis L. Oglesby, Ill., President and Manager, Illinois Clay Products Co.

Jones, Richard E., 904 Lock St., Tarentum, Pa., Pittsburgh Plate Glass Co.

Justice, Ithamar M., Dayton, O., Vice-President, Manufacturers Epuipment Co.

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† Elevated to Active Membership, February, 1921.

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Kanengeiser, Fred R., Poland, O.

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Kempf, John R., Detroit, Mich., Star Corundum Wheel Co.

Kendrick, Lucius S., 513 Bearinger Bldg., Saginaw, Mich., Vice-President and General Manager, Central Michigan Clay Products Co.

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King, Walter A., Elyria, O., Assistant, Enamel Research Laboratory, Elyria Enameled Products Co.

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Kleinfeldt, Henry F., 220 Broadway, New York City, Secretary, Abbe Engineering Co.

Kline, Z. C., Central Falls, R. I., National Lamp Works.

Knapp, E. W., Dayton, O., Manufacturers Epuipment Co.

Knowles, H. H. Santa Clara, Cal., President, The Homer Knowles Pottery Co.

Knowles, W. V., Peoples Gas Bldg., Chicago, Ill., District Manager and Technical Representative, Titanium Alloy Manufacturing Co., Buckman & Pritchard, Inc.

Koch, A. L., 1898 Berkeley Ave., St. Paul, Minn.

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†Elevated to Active Membership, February, 1921.

Koch, Charles F., Cincinnati, O., National Sales Co.
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Koos, E. K., New Cumberland, W. Va., Chelsea China Co.
Koupal, Walter G., Creighton, Pa., Chemist, Pittsburgh Plate Glass Co.
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Kraus, Louis P., Jr., Klondyke, O., Vice-President, Kraus Research Laboratories, Inc.
Kraus, Lysle R., 159 Forest Ave., West Englewood, N. J., Secretary, Kraus Research Laboratories, Inc.
Krause, George, R. F. D. 1, Zanesville, O.
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Kreger, John M., Woodbridge, N. J., Woodbridge Ceramic Corp.
Krekel, Albert, 1917 W. Fayette St, Baltimore, Md., Engineer, Porcelain Enamel and Manufacturing Co.
†**Krusen, I. Andrew**, Joliet, Ill., American Refractories Co.
†**Kurtz, John C.**, Rochester, N. Y., Bausch & Lomb Optical Co.
Kurtz, Thomas N., Claysburg, Pa., Standard Refractories Co.
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Lamborn, Lloyd, 118 E. 28th St., New York City, Editor, "Chemical Age."
†**Lamont, R. A., Jr.**, Salem, O., General Manager, National Sanitary Co.
Langworthy, H. S., Jewettville, N. Y., Vice President and Superintendent, Jewettville Clay Products Co.
Lapp, G. W., Leroy, N. Y., Electrical Engineer, Lapp Insulator Co.
Lardin, R. H., Creighton, Pa., Assistant Chemist, Pittsburgh Plate Glass Co.
Larkins, Samuel B., Salineville, O., Superintendent, National China Co.
Larson, Gustaf, 503 Security Bldg., Los Angeles, Cal., Los Angeles Brick Co.
Laughlin, Samuel O., Wheeling, W. Va., President and General Manager, Wheeling Tile Co.
Lawler, John J., 839 Thomas Ave., Forest Park, Ill., Salesman, Jas. H. Rhodes & Co.
Lawson, Carl H., 1 Wildey Ave., Worcester, Mass., Norton Co.
Lawson, George G., 2525 Clybourn Ave., Chicago, Ill., Northwestern Terra Cotta Co.

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†Elevated to Active Membership, February, 1921.

Lawton, Lewis H., Trenton, N. J., Secretary and General Manager, Jonathan Bartley Crucible Co.

Legg, Victor E., 330 Vinewood Ave., Detroit, Mich., Research Physicist, Detroit Edison Co.

Lemley, W. E., Taylor, Wash., Superintendent, Denny-Renton Clay and Coal Co.

Levings, G. v. B., Seneca, Mo., Resident Manager, American Tripoli Co.

Lewis, E. S., 29 S. LaSalle St., Chicago, Ill., Secretary-Treasurer, Advance Terra Cotta Co.

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Lindley, Jacob, Tiltonville, O., Riverside Potteries Co.

Lindmueller, Charles, East Chicago, Ind., Superintendent, Metal and Thermit Corp.

Lindsay, Geo. W., Denver, Col., Factory Superintendent, Denver Fire Clay Co.

Lindsay, Robert F., 2066 Albion St., Denver, Col., Denver Fire Clay Co.

Lintz, E. H., Lackawanna, N. Y., Jewett Refrigerator Co.

Lippert, Charles G., (address unknown)

Little, E. C., 1673 Railway Exchange Bldg., St. Louis, Mo., Assistant Sales Manager, Laclede-Christy Clay Products Co.

Little, H. B., Baltimore, Md., President, Baltimore Enamel and Novelty Co.

Littleton, J. T., Jr., Ph. D., Corning, N. Y., Chief, Physical Laboratory, Corning Glass Works.

Liu, S. Y., Ithaca, N. Y., Cornell University.

Livingston, H. J., Buffalo, N. Y., National Grinding Wheel Co.

Lloyd, A., Washington, Pa., Superintendent, Hazel Factory No. 2, Hazel-Atlas Glass Co.

Locke, F. M., Victor, N. Y.

Long, R. N., Woodbridge, N. J., Federal Terra Cotta Co.

Lord, F. G., Lewiston, Pa., Sales Manager, Pennsylvania Pulverizing Co.

Lord, N. W., Jr., 338 W. 8th Ave., Columbus, O., Student Ohio State University.

Louthan, Wm. B., East Liverpool, O., Manager, Louthan Manufacturing Co.

Lovatt, John, 1308 Brunswick Bldg., Trenton, N. J., Kiln Builder.

Luepke, Emil J., 2001 S. Kingshighway, St. Louis, Mo., Foreman, Quick Meal Stove Co.

Luke, Chas. H., New Bethlehem, Pa., Climax Fire Brick Co.

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† Elevated to Active Membership, February, 1921.

Luter, Clark A., 401-4 Lobe Bldg., South Gay St., Baltimore, Md., Consulting Ceramist.

Lyon, J. Boyd, St. Louis, Mo., Laclede-Christy Clay Products Co.

Lyon, P. W., 1332 Frick Bldg., Pittsburgh, Pa., Special Representative, American Sheet and Tin Plate Co.

McAllister, James E., Trenton, N. J., Ceramist, J. L. Mott Co.

McCauley, Geo. V., Corning, N. Y., Physicist, Corning Glass Works.

McClafferty, Harry J., 2124 Andrews St., Rockford, Ill., Superintendent, Rockford Viterous Enamel Co.

McCormick, O. C., Bedford, O., Bedford China Co.

McDowell, S. J., Flint, Mich., Ceramic Engineer, Champion Ignition Co.

McGee, Earle N., Syracuse, N. Y., Research Laboratory, Semet-Solvay Co.

McHose, Malcolm M., Perth Amboy, N. J., Manager, L. H. McHose, Inc.

McKaig, W. Wallace, Cumberland, Md., McKaig Machine Foundry and Supply Works, Wellington Glass Co.

McKelvey, John H., St. Louis, Mo., Sales Manager, Laclede-Christy Clay Products Co.

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†**McKinley, J. M.**, Curwensville, Pa., Crescent Refractories Co.

McLaughlin, John, Box 31, Tiltonsville, O., Presser, Wheeling Sanitary Manufacturing Co.

MacMichael, P. S., Auburn, Wash., President, Northern Clay Co.

McMillan, H. B., Lincoln, Cal., Assistant Ceramic Chemist, Gladding McBean & Co.

McMillan, Herbert S., Detroit, Mich., Secretary and Manager, Porcelain Enameling and Manufacturing Co.

McNaughton, Malcolm, Jersey City, N. J., Superintendent, Joseph Dixon Crucible Co.

McPadden, J. H., 26 Cortlandt St., New York City, Secretary, Quigley Furnace Specialties Co.

McVay, T. M., Kenova, W. Va., Basic Products Co.

Maddock, John, Trenton, N. J., John Maddock & Sons.

Maddock, John B., Trenton, N. J., John Maddock & Sons.

Mahoney, W. T., Chattanooga, Tenn., Assistant General Manager, Cahill Iron Works.

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Malkin, Wm. R., Box 669, Wheeling, W. Va.

Mandle, I., 1318 Wright Bldg., St. Louis, Mo., Secretary and Treasurer, Mandle Clay Mining Co.

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†Elevated to Active Membership, February, 1921.

Mandle, Sidney, Whitlock, Tenn., Assistant Treasurer, Mandle Clay Mining Co.

†**Manion, L. W.,** 1370 Greenfield Ave., S. W., Canton, O., Designer and Builder of Enameling Furnaces.

Manor, John M., East Liverpool, O., Manager, Golding Sons Co.

Manson, Mahlon E., Milwaukee, Wis., Chemist, Rundle Manufacturing Co.

Marks, Melville, 29 Broadway, New York City, Moore & Munger.

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Miller, Emerson R., Zanesville, O., Salesman, Mosaic Tile Co.

Miller, Julius J., Pittsburgh, Pa., Koppers Company, Mellon Institute.

Miller, R. W., (address unknown)

Milligan, Frank W., Parkersburg, W. Va., Manager, General Porcelain Co.

Mills, H. F., Noblesville, Ind.

Minehart, A. G., Jr., Toledo, O., Manager, The Rock Products Co.

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†Elevated to Active Membership, February, 1921.

Minton, C. R., Box 14, Seville, Ohio.

Minton, G. Z., Creighton, Pa., Ceramic Engineer, Pittsburgh Plate Glass Co.

Mitchell, Leon W., Rock Island, Ill., Superintendent, Rock Island Stove Co.

Mitscherling, W. O., Ph. D., Landing, N. J., Atlas Powder Co.

Moncrieff, James W., 428 E. Pine St., Stockton, Cal.

Moore, Earl J., Bldg. Y-7, Camp Sherman, O.

Moore, E. S., Ph. D., State College, Pa., Dean, School of Mines, Pennsylvania State College.

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†**Morey, George W.**, 2801 Upton St., Washington, D. C., Geophysical Laboratory.

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Motz, W. H., Akron, O., Secretary and Treasurer, Colonial Sign and Insulator Co.

Moulding, J. W., 1203 Chamber of Commerce Bldg., Chicago, Ill., Tiffany Enameled Brick Co.

Moulton, D. A., Mexico, Mo.

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Myers, Charles H., 498½ Poplar St., Murray, Utah, Superintendent, Utah Fire Clay Co.

Myers, Elmer E., Brookville, Pa., Brookville Glass and Tile Co.

Myers, Scott P., Uhrichsville, O., Uhrichsville Clay Co.

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Nagle, Michael F., 210 John St., South Amboy, N. J., Superintendent, South Amboy Terra Cotta Co.

Navias, Louis, 203 Ceramics Bldg., University of Illinois, Urbana, Ill.

Niblock, Charles, Zanesville, O., American Encaustic Tiling Co.

Nies, Frederick, H., D. D. S., Corner Hamilton Ave. and Summit St., Brooklyn, N. Y.

Niles, Glenn H., 24 State St., New York City, Engineer, The Improved Equipment Co.

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† Elevated to Active Membership, February, 1921.

Nitchie, Charles C., Depue, Ill., Chief Chemist, Mineral Point Zinc Co.
Nolan, C. J., Toledo, O., General Manager, Modern Glass Co.,
Nye, C. P., Uniontown, Pa., Manager, Richmond Radiator Co.
Oakley, Walter W., 32 E. Second St., Corning, N. Y., Corning Glass Works.
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Ogale, G. P., Pittsburgh, Pa., Mellon Institute.
Ogden, D. P., Streator, Ill., Engineer, Streator Brick Co.
O'Hara, Eliot, 46 Greenwood Lane, Waltham, Mass., Manager, O'Hara Waltham Dial Co.
O'Leary, T. A., 1212 Keenan Bldg., Pittsburgh, Pa., President, T. A. O'Leary Co., Inc., and Enid Clay Co., Inc.
Olson, Peter C., 150 Nassau St., New York City.
Ossowski, Charles S., (address unknown).
Overbeck, Elizabeth G., Cambridge City, Ind., Overbeck Pottery.
Owens, F. W., 654 W. Franklin St., Baltimore, Md.
Owens, J. B., Zanesville, O.
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Panchot, L. D., Box 325, Ford City, Pa., Second Assistant Superintendent, Pittsburgh Plate Glass Co.
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†**Pass, R. H.**, Syracuse, N. Y., Onondaga Pottery Co.
Patch, James B., 40 Howard St., Millville, N. J., Chemist, Whitall Tatum Co.
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Paul, William W., 1550 W. Euclid St., Detroit, Mich., Superintendent, Wolverine Porcelain Enameling Co.
†**Payne, A. R.**, Clarksburg, W. Va., Chief Physicist, Hazel Atlas Glass Co.
Pearson, Howard L., Mexico, Mo., Engineer, A. P. Green Fire Brick Co.
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Pellerano, Silvio, 1837 Seventy-first St., Brooklyn, N. Y., Assistant Chemist, Hemming Mfg Co., Garfield, N. J.

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† Elevated to Active Membership, February, 1921.

Pelton, Herbert E., 844 Fifth Ave., Los Angeles, Cal., Secretary and Treasurer, West Coast Tile Co., Inc.

Pendrup, W., Cicero, Ill., Superintendent, Enameling Department, Coonley Mfg Co.

Penfield, L. W., Bucyrus, O., Hadfield-Penfield Steel Co.

Penfield, R. C., 1619 Conway Bldg., Chicago, Ill., Hadfield-Penfield Steel Co.

Perg, Carl, 609 W. Kalamazoo Ave., Kalamazoo, Mich., Enameler.

Pfalzgraf, Charles F., Baltimore, Md., President, Baltimore Stamping and Enameling Co.

Pfeiff, C. H., 145 Rector St., Perth Amboy, N. J., Superintendent, General Ceramics Co.

Philips, Wilson A., Trenton, N. J., President, Philips-Harper Co.

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Pitcock, Lawrence, Crooksville, O., Superintendent, Crooksville China Co.

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Post, Albert H., Waterville, Conn., Superintendent, Gordon Electric Manufacturing Co.

†**Post, M. P.**, Commerce, Mo., Superintendent, Post Brothers.

Potter, William A., Richmond, Cal., Factory Manager, Pacific Porcelain Ware Co.

Powell, R. E., 8700 S. State St., Chicago, Ill., Chief Engineer, Federal Electric Co.

Preston, F. C., 509 Cuyahoga Bldg., Cleveland, O., Vice President and Sales Manager, Dover Fire Brick Co.

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†Elevated to Active Membership, February, 1921.

Primley, Walter S., 1014 Chamber of Commerce Bldg., Chicago, Ill., Midland Terra Cotta Co.

Pritchard, G. A., 94 Fulton St., New York City, Second Vice President, Buckman & Pritchard, Inc.

Proodian, E. K., (address unknown)

Pulsifer, H. M., (address unknown).

Pyatt, Frank E., Perrysville, O.

Quaintance, Charles F., Golden, Col., Secretary, Coors Porcelain Co.

Rabun, Wiley T., 124 N. Santa Fe Ave., Huntington Park, Los Angeles, Cal., Foundryman, Whiting-Mead Commercial Co.

Radabaugh, N. B., 1572 Rydal Mount Rd., Cleveland, O., President, The Phœnix Hardening Equipment Co.

Ragland, Nugent A., 1280 W. Adams St., Los Angeles, Cal.

Rahn, Robert C., 4642 West End Ave., Chicago, Ill., Ceramic Engineer, Western Electric Co.

Raiff, David A., Coshocton, O., Enameler, Beach Enameling Co.

Ramsay, Andrew, Mt. Savage, Md., The Andrew Ramsay Co.

†**Ramsay, J. D.**, St. Marys, Pa., President and General Manager, Elk Fire Brick Co.

Ramsdell, Lewis S., 29 West St., Worcester, Mass., Norton Co.

Rancke, Louis, N., 12th and M. Sts., S. E., Washington, D. C., Consulting Engineer-Chemist.

Randall, James E., Indianapolis, Ind., Junior Editor, "The Clayworker."

Rapp, John A., 1244 Chicago Ave., Evanston, Ill.

Rathjens, G. W., 240 W. George St., St. Paul, Minn.

Rawson, Cummins, Des Moines, Ia., Iowa Pipe and Tile Co.

Reagan, F. H., Victor, N. Y., General Manager, Locke Insulator Co.

Reddick, W. L., Grafton, W. Va., Superintendent, Hazel-Atlas Glass Co.

Reeb, H. E., 269 S. 18th St., Columbus, O.

Reed, Adam, Zanesville, O., President, Peters & Reed Pottery Co.

Reedy, A. J., Battle Creek, Mich., Superintendent, A–B Stove Co.

Reid, W. H., 10 Stanley Place, Yonkers, N. Y., Consolidated Gas Company of New York.

Reinecker, Haydn P., 145 Industrial Bldg., Washington, D. C., Chemist, U. S. Bureau of Standards.

Rentschler, M. J., Willoughby, O., General Manager, J. H. R. Products Co.

Rhead, Mrs. Frederick H., Zanesville, O.

Rhead, Harry W., 144 Putnam Ave., Zanesville, O., Designer, Roseville Pottery Co.

Rheads, Ralph S., (address unknown)

Rhodes, George E., 1609 N. Webster St., Kokomo, Ind., Vice President and General Manager, Kokomo Sanitary Pottery Co.

Riblet, Bertha, 2047 E. 115th St., Cleveland, O.

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†Elevated to Active Membership, February, 1921.

Richard, L. M., 1401 Rialto Blvd., Venice, Cal.

Richardson, E. A., Toledo, O., Libbey Glass Manufacturing Co.

Richardson, P. B., 210 Otis St., East Cambridge, Mass., Salesman, Harbison-Walker Sales Co.

Riley, R. J., Indianapolis, Ind., Indianapolis Terra Cotta Co.

Risch, Edward J., 4742 W. Adams St., Chicago, Ill., Head Draftsman, Midland Terra Cotta Co.

Ritschy, Donald P., Tacony, Philadelphia, Pa., Keystone Lantern Co.

Ritter, J. F., Evansville, Ind., Manager, Evansville Enameling Co.

Rixford, Guy L., Rocky River, Cleveland, Ohio, Cowan Pottery.

Roberts, Frank G., 8th and O'Donnel Sts., Baltimore, Md., Service Engineer, Porcelain Enamel and Manufacturing Co.

Roberts, Jane E., Iowa City, Ia., Librarian, State University of Iowa.

Robertson, Fred H., 809 North Alvarado St., Los Angeles, Cal., Los Angeles Pressed Brick Co.

Robertson, H. S., Pittsburgh, Pa., Harbison-Walker Refractories Co.

Robineau, S. E., 108 Pearl St., Syracuse, N. Y., President, Keramic Studio Publishing Co.

Robinson, J. D., Toledo, O., President, Libbey Glass Manufacturing Co.

Robinson, Louis G., Harrison Bldg., Cincinnati, O., Cincinnati Testing Bureau.

†**Rochow, W. F.**, Pittsburgh, Pa., Chemical Engineer, Harbison-Walker Refractories Co.

Roddewig, Ed., 411 Harrison St., Davenport, Ia.

Rogers, Frederick W., Beaver Dam, Wis., Malleable Iron Range Co.

Rogers, Gregory L., Renton, Wash., Denny-Renton Clay and Coal Co.

Rogers, Jas. B., 6231 St. Lawrence Ave., Chicago, Ill., Experimental Engineer.

Rogers, Thomas S., Chicago, Ill., Special Representative, National Silica Co.

Roll, Edw. E., 1037 Ansel Rd., Cleveland, O.

Rupp, Edwin M., 714 Lincoln Ave., Middletown, O., Student, Ohio State University.

Rusoff, Samuel, Anderson, Ind., Ceramic Engineer, National Tile Co.

†**Russel, John W.**, 522 Chestnut St., Columbia, Pa., President, Marietta Hollow Ware and Enameling Co.

Ryan, John F., Woodbridge, N. J., Secretary and Manager, Mutton Hollow Fire Brick Co.

Ryan, J. J., 810 Sumpter Bldg., Dallas, Tex., Production Manager, Secretary-Treasurer, Fraser Brick Co.

Ryan, Lawrence C., Woodbridge, N. J., Assistant Manager, Mutton Hollow Fire Brick Co.

Ryan, P. Joseph, Woodbridge, N. J., President, Mutton Hollow Fire Brick Co.

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† Elevated to Active Membership, February, 1921.

Sant, Richard C., East Liverpool, O., Secretary, The John Sant & Sons Co.

Sassetti, F. L., 114 E. Grand Ave., Chicago, Ill., Florence Art Co.

Sauereisen, C. Fred, 1335 Point View St., Pittsburgh, Pa.

Saunders, A. E., 142 Kingsland Ave., Corona, L. I., N. Y.

Saunders, Lewis E., 262 Salisbury St., Worcester, Mass., Manager, Research and Abrasive Plants, Norton Co.

Saxe, C. W., 54 W. Boylston St., Worcester, Mass., Norton Co.

Schaeffer, John A., St. Louis, Mo., Vice-President, Eagle-Picher Lead Co.

Schermerhorn, Joseph A., 938 Carteret Ave., Trenton, N. J., Trenton Porcelain Co.

Schmid, A. F., 1400 Wheeling Ave., Zanesville, O., Superintendent, Zanesville Art Pottery Co.

†**Scholes, Samuel R., Ph. D.**, Columbus, O., Chemist, Federal Glass Co.

Schoneich, Philip A., Pittsfield, Mass., General Foreman, Pittsfield Porcelain Works.

Schramm, Edward, 574 Whittier Ave., Syracuse, N. Y., Research Chemist, Onondaga Pottery Co.

Schulze, John F. W., Edgewood, Md., Edgewood Arsenal.

Schurtz, D. D., Lancaster, O., Sharp-Schurtz Co.

Schwetye, Fred H., St. Louis, Mo., Superintendent, Laclede-Christy Clay Products Co.

Scott, David H., Muncie, Ind., Ball Brothers Glass Manufacturing Co.

Scott, M. R., 1220 Lake Ave., Rochester, N. Y., Bausch & Lomb Optical Co.

Seasholtz, J. M., Front and Spruce Sts., Reading, Pa., Owner, Porcelain Enameling Plant.

Sebring, F. H., Jr., Salem, O., President, The Salem China Co.

Sewell, Sidney I., Arnold, Pa., American Window Glass Co.

†**Sharp, Chester L.**, Lancaster, O., Sharp-Schurtz Co.

Sharp, Donald E., Hamburg, N. Y., Spencer Lens Co.

†**Shaw, L. I., Ph. D.**, Washington, D. C., Assistant Chief Chemist, U. S. Bureau of Mines.

Shaw, Lucian, West Lafayette, O., Secretary, The West Lafayette Manufacturing Co.

Sheehy, J. F., Newport, Ky., Superintendent and Manager, Alhambra Tile Co.

Sheppard, Mark, Norristown, Pa., E. J. Lavino & Co.

Sherwood, Robert, 143 Industrial Bldg., Washington, D. C., U. S. Bureau of Standards.

Shively, R. R., Ph. D., Fairmont, W. Va., Chemical Engineer, Monongah Glass Co.

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† Elevated to Active Membership, February, 1921.

Short, Frank, University Club, Washington, D. C., Expert in Aircraft Armament, Ordnance Department, Frankford Arsenal.

Shultz, J. Emmet, Zanesville, O., Modeler, American Encaustic Tiling Co.

Silver, Anna K., 9 Hawthorne St., Worcester, Mass., Analytical Division, Norton Co.

Silvers, James L., Trenton, N. J., Manager, Trent Tile Co., Inc.

Sladek, George E., Beaver Falls, Pa., Beaver Falls Art Tile Co.

Slater, W. M., 622 F St., N. W., Washington, D. C., President, American Rutile Co.

Sloan, Alex, Box 410, Cumberland, Md., Manufacturing Chemist.

Slobodkin, S. H., 146 Condor St., East Boston, Mass., Boston Pottery Co., Inc.

Smith, A. M., 401 Columbia Bldg., Portland, Oregon.

Smith, Charles A., 1150 Oak St., Columbus, O., Student, Ohio State University.

Smith, Harry W., Box 360, Cleveland, O., Roessler & Hasslacher Chemical Co.

Smith, H. Dan, East Liverpool, O., Superintendent, Smith-Phillips China Co.

Smith, Maurice A., Jeanette, Pa., Vice-President and General Manager, McKee Glass Co.

Smith, Norman G., Brunswick, Me., Manager and Treasurer, Maine Feldspar Co.

Smith, Perry A., New Brighton, Pa., Secretary, A. F. Smith Co.

Smith, R. G., Fort Worth, Texas, Plant Manager, Acme Brick Co.

Smith, Wilbur R., Minotola, N. J., Illinois Glass Co.

Smoot, C. E., 1900 Santa Fe Ave., Los Angeles, Cal., President American Enameling and Stamping Co.

Smyser, Albert E., 239 South Fairmount St., E. E., Pittsburgh, Pa., Engineer of Refractories, Koppers Co.

Snider, Paul C., 37 Southard Ave., Zanesville, O., Research Department, American Encaustic Tiling Co.

†**Solon, Leon V.,** Magnolia Ave., Tenafly, N. J.

†**Sortwell, H. H.,** 143 Industrial Bldg., Washington, D. C., U. S. Bureau of Standards.

Speir, Harry F., 15 Park Row, New York City, President, New Jersey Pulverizing Co.

Stallings, A. G. T., Mexico, Mo., Superintendent, A. P. Green Fire Brick Co.

Stangl, J. M., Flemington, N. J., Factory Manager, Fulper Pottery Co.

Stepan, A. C., 589 E. Illinois St., Chicago, Ill., Manager, Roessler & Hasslacher Chemical Co.

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†Elevated to Active Membership, February, 1921.

Stern, Newton W., 67 New Montgomery St., San Francisco, Cal., Secretary and Treasurer, Pacific Porcelain Ware Co.

Stevenson, Wm. G., Oregon, Ill., Secretary-Treasurer, Ohio Silica Co.

Stewart, Andrew H., Pittsburgh, Pa., Mellon Institute.

Stewart, John G., 530 Union Trust Bldg., Cincinnati, O., District Manager, Stephens Adamson Mfg Co., Aurora, Ill.

Stockdale, V. B., 609 W. Meek St., Abingdon, Ill., Superintendent, Abingdon Sanitary Mfg Co.

Stockton-Abbott, Lyle, 11 Broadway, New York City, Celite Products Co.

Stone, Chas. A., 3226 Potomac Ave., Chicago, Ill.

†**Stone, Charles H., Jr.**, 11110 Detroit Ave., Cleveland, O., Research and Industrial Chemist, Kemet Laboratories Co.

Stone, George C., 160 Front St., New York City, New Jersey Zinc Co.

Stoneman, Wm. N., Charleroi, Pa., Chemist, Macbeth Evans Glass Co.

Storey, O. W., Madison, Wis., Metallurgist, C. F. Burgess Laboratories.

Stover, J. Homer, 176 Grant Ave., Nutley, N. J., Sales Manager, John Johnson Co., Brooklyn.

Stowe, G. T., Leader News Bldg., Cleveland, O., The Cleveland Builders Supply and Brick Co.

Strommer, L. T., 13507 Garden Ave., East Cleveland, O., American Dressler Tunnel Kilns, Inc.

†**Strong, Thos. L.**, West Lafayette, O., General Manager, Lafayette Stamping and Enameling Co.

Stull, Jos. M., Crum Lynne, Pa., Ceramist, O. W. Ketcham Terra Cotta Works.

Sutton, Willard J., 236 Bellefield Ave., Pittsburgh, Pa., Assistant and Graduate Student, University of Pittsburgh.

Swalm, Phaon H., Wheeling, W. Va., Wheeling Tile Co.

Swift, George C., 2029 E. 115th St., Cleveland, O., Superintendent, Enamel Products Co.

Swinnerton, B. B., 126 E. Main St., Lancaster, O., American Dressler Tunnel Kilns, Inc.

Swope, H. J., Quincy, Ill., Business Manager, Economy Enameling Co.

Tait, Howard J., Monaca, Pa., Phœnix Glass Co.

Tatton, Joseph, Y. M. C. A. Bldg., South Amboy, N. J.

Taylor, R. F., 40 Falls St., Niagara Falls, N. Y.

Taylor, R. P., Roseland, Nelson Co., Va., Superintendent, Klimax Kaolin Co.

Taylor, Wm. C., Corning, N. Y., Corning Glass Works.

Tefft, T. Dwight (address unknown)

Theobald, Erwin F., Magnolia, O., Ceramic Engineer, National Fire Proofing Co.

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† Elevated to Active Membership, February, 1921.

Thomas, Chauncey R., 2336 San Pablo Ave., Berkeley, Cal., "The Tile Shop."

Thomas, George E., St. Louis, Mo., General Superintendent, Highlands Fire Clay Co.

Thomas, George W., East Liverpool, O., President, R. Thomas & Sons Co.

Thomas, James R., Crawfordsville, Ind., Manager, Standard Brick Co.

Thompson, Harry M., Washington, Pa., Furnace Engineer, Simplex Engineering Co.

Thurliman, Leo, 4716 N. Talman Ave., Chicago, Ill.

Thwing, C. B., Ph. D., Philadelphia, Pa., President, Thwing Instrument Co.

Tiebout, Cornelius H., Jr., 99 Commercial St., Brooklyn, N. Y., Gleason-Tiebout Glass Co.

Tillotson, George S., 43 Water St., Tiffin, O., Sterling Grinding Wheel Co.

Tilton, C. B., 21 Elbridge St., Worcester, Mass., Norton Co.

Timmerman, Walter F., Kansas City, Kan., Vice President, Western Terra Cotta Co.

Trace, A. R., Hobart, Ind., National Fire Proofing Co.

Trifonoff, Boris, Zanesville, O., American Encaustic Tiling Co.

Trood, Samuel (address unknown)

Troutman, Frank E., Butler, Pa., Secretary-Treasurer, Standard Plate Glass Co.

Trowbridge, Prentiss S., 1337 Kings Highway, St. Louis, Mo., Hydraulic Pressed Brick Co.

Truby, H. A., Creighton, Pa., Research Department, Pittsburgh Plate Glass Co.

Tucker, Gus M., 401 Vernon Ave., Long Island City, N. Y., Ceramic Chemist, New York Architectural Terra Cotta Co.

†**Turk, Karl**, 116 W. Hamilton Ave., Baltimore, Md., President, Porcelain Enamel and Manufacturing Co.

Turnbull, Lance, East Liverpool, O., Salesman, Johnson-Porter Clay Co.

Turner, James, Trenton, N. J., Cook China Co.

Twells, Robert, Jr., 4401 Avery St., Detroit, Mich., Jeffery-Dewitt Co.

Twining, F. E., Fresno, Cal., Manager, The Twining Laboratories.

†**Tyler, H. B.**, 216 Gibson St., Canandaigua, N. Y., Superintendent, Enamel Department, Lisk Manufacturing Co.

Unger, J. S., 1054 Frick Annex, Pittsburgh, Pa., Manager, Central Research Bureau, Carnegie Steel Co.

Vance, Edward D., Springfield, O., Ceramic Engineer, Safety Emery Wheel Co.

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† Elevated to Active Membership, February, 1921.

VanCleave, A. A., 5031 Tyler Ave., St. Louis, Mo.

Vane, A. S., 8300 Torresdale Ave., Philadelphia, Pa., Precision Grinding Wheel Co., Inc.

Van Moore, A. L., 213 Locust St., New Kensington, Pa., American Photo. Glass and Export Co., New Eagle, Pa.

Varshnei, B. D., 3610 Fifth Ave., Pittsburgh, Pa.

Vincent, Harry S., Fort Dodge, Ia., President, Vincent Clay Products Co.

Vodick, William J., 1733 Lake Ave., Wilmette, Ill., Chicago Hardware Foundry Co.

Vogt, C. C., Pittsburgh, Pa., Mellon Institute.

†**Vollkommer, Josef**, Bessemer Bldg., Pittsburgh, Pa., President and Manager, Vitro Manufacturing Co.

Vollmer, August, Jr., 5240-46 Northrup Ave., St. Louis, Mo., St. Louis Pottery and Manufacturing Co.

†**Vollrath, W. J.**, Sheboygan, Wis., President, Porcelain Enameling Association.

Wainford, Richard H., 203 E. State St., Trenton, N. J., President, Trenton Flint and Spar Co.

Walcott, A. J., 41 Prince St., Rochester, N. Y., Research Physicist, Bausch & Lomb Optical Co.

Walker, Chas. H., 1417 St. Clair Ave., Station 2, East Liverpool, O., Assistant Superintendent, Homer-Laughlin China Co.

Walker, Prescott H., 631 Main St., Niagara Falls, N. Y., Ceramic Chemist, Carborundum Co.

Waller, Alfred E., Lawrence Park, Bronxville, N. Y., Chief Engineer, Ward Leonard Electric Co.

Walton, H. K., 59 Pearl St., New York City, New York Agent, Thwing Instrument Co.

†**Walton, S. F.**, 110 Brookline Ave., Boston, Mass., Kalmus, Comstock & Wescott, Inc.

Watkins, Ray T., R. F. D. No. 1, Blacklick, O., U. S. Bureau of Mines, Columbus, O.

Watson, Harold L., West Lynn, Mass., Research Division Optical Glass, Thomson Laboratory, General Electric Co.

Weaver, James P., Box 658, Belle Vernon, Pa., Chemist, American Window Glass Co.

Weber, August, Jr., 1 Stratford Road, Schenectady, N. Y., President, Weber Electric Co.

Webster, Henry, 628 Lexington Ave., Newport, Ky., Henry Webster & Sons.

Weigel, Chas., Hebron, N. Dak., President, Hebron Fire and Pressed Brick Co.

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† Elevated to Active Membership, February, 1921.

†**Weil, Edgar H.**, Cleveland, O., President, Vitreous Enameling Co.

Weller, Samuel A., North 6th St., Zanesville, O., Owner, S. A. Weller Art Pottery.

Wells, R. D., Royersford, Pa., Factory Manager, The Floyd Wells Co.

Wenning, W. F., 3313 Allendale St., Pittsburgh, Pa., Research Department, Vitro Manufacturing Co.

Wethey, A. H., Jr., 83 Fifth St., Portland, Ore., Secretary and Manager, Standard Brick and Tile Co.

Wey, Harold B., 1302 Third National Bank Bldg., Atlanta, Ga., Vice President and General Manager, Atlanta Terra Cotta Co.

Wherry, James B., Omaha, Neb., Research Chemist, Refinite Co.

White, Ray H., Niagara Falls, N. Y., Research Engineer, Norton Co.

White, Richard P., 121 S. Menard Ave., Chicago, Ill., Secretary-Treasurer, Union Stoneware Co.

Whitehead, Fred, 747 New York Ave., Trenton, N. J., Superintendent, Electrical Porcelain and Manufacturing Co.

Whitehead, Ralph R., Woodstock, N. Y., Byrdcliff Pottery.

Whittemore, John W., 2166 Lincoln Way, Ames, Ia., Student, Iowa State College.

Wiester, Stefan, N. 28th St., Belleville, Ill., Roesh Enameled Range Co.

Wigfield, C. L., 339 Fifteenth St., Elyria, O., Elyria Enameled Products Co.

†**Wilkins, Wm. W.**, 5061 N. Robey St., Chicago, Ill., Claycraft Shops, Lewis Institute.

†**Wilkinson, Geo. D.**, Chicago, Ill., Vice President, Cribben & Sexton Co.

Wilkinson, Samuel, Box 757, Trenton, N. J.

†**Willetts, H. G.**, S. 10th St., Pittsburgh, Pa., The Willetts Co.

Williams, C. W., 720 Electric Bldg., Cleveland, O., Harshaw, Fuller & Goodwin Co.

Williams, George A., 173 Johnson Ave., Tottenville, S. I., N. Y., Chemist, Atlantic Terra Cotta Co., Perth Amboy, N. J.

Williams, John A., Prospect St. and P. & R. R. R., Trenton, N. J., Factory Manager, Mitchell-Bissell Co.

†**Williams, Warren S.**, Arnold, Pa., American Window Glass Co.

Winkleman, E. J., Box 1122, Pittsburgh, Pa., Chief Engineer, American Refractories Co.

Wong, Y. Y., 320 N. Hill St., Los Angeles, Cal.

Wood, A. T., Kenova, W. Va., General Manager, Basic Products Co.

Wood, C. P., Stock Exchange Bldg., Philadelphia, Pa., Manager, Philadelphia Office, Lockwood, Greene & Co.

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†Elevated to Active Membership, February, 1921.

Wood, O. A., 720 Walnut Ave., Fairmont, W. Va., Treasurer and Superintendent, Fairmont Window Glass Corp.

Woods, Wm. J., Lewistown, Pa., Assistant General Manager, Pennsylvania Pulverizing Co.

Worsham, Edgar A., Baltimore, Md., Assistant Treasurer, Porcelain Enamel and Manufacturing Co.

Worsham, Herman, 1144 Prudential Bldg., Buffalo, N. Y., Sales Engineer, Carrier Engineering Corp.

Worth, S. Harry, 404 Franklin Trust Bldg., Philadelphia, Pa., President, Pennsylvania Feldspar Co.

Wright, Harry E., Kokomo, Ind., Kokomo Opalescent Glass Co.

Wright, John M., Box 413, Trenton, N. J., Secretary and Treasurer, Golding Sons Co.

Wright, Marcus S., South River, N. J., Miner & Shipper, Foundry Sands and Clay.

Wry, Thomas A., Lynn, Mass., Mechanical Engineer, General Electric Co.

Yearsley, Howard L., 317 Washington Ave., Haddonfield, N. J.

Yingling, Walter A., Winchester, Ind., Superintendent, Woodbury Glass Co.

Young, C. B., Newark, O., General Manager, The Central Refractories Co.

Young, Everett T., Peekskill, N. Y., President, Peekskill Fire Brick Works.

Young, Russell T., Zanesville, O., Secretary, Roseville Pottery Co.

Yowell, J. B., Dudley, Ill.

Yuill, John W., 4435 Magron St., East Chicago, Ind.

Yung, W. A., Harrison, N. J., Harrison Bulb Works of General Electric Co.

Zakharoff, A., Box 684, Chicago, Ill.

Zeiller, Oscar F., New York, N. Y., Secretary, B. F. Drakenfeld & Co. Inc.

†**Zopfi Albert S.**, Toledo, O., Secretary, Buckeye Clay Pot Co.

Zwermann, Carl H., 306 S. Cross St., Robinson, Ill.

†**Zwermann, Theodore**, 22 Seventeenth St., Newark, O., Enameling Superintendent.

Zwerner, Carl G., Auburn, Wash., Northern Clay Co.

FOREIGN ASSOCIATE MEMBERS

†**Andersen, Olaf**, Statsgeolog, Mineralogisk Museum, Kristiania, Norway, Norwegian Government Geologist, Director of Research Laboratory.

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†Elevated to Active Membership, February, 1921.

Aoki, S., Futajima, Ongagun, Fukuoka, Japan, American-Japan Sheet Glass Co.

Barrett, Maurice, 17 Gledhow Ave., Leeds, England.

Bateson, H. A., Spekeland Rd., Edge Hill, Liverpool, England.

Berland, Louis, 10 Grande Rue, Villejuif, Seine, France, Director de la Societe Nouvelle de la Manufacture de Porcelaines de Ste. Fay l'Argentiere.

Bianchedi, Romulo, Calle Junin 1028, Buenos Aires, Argentina, Head of Piccardo y Cia's Glass Works.

†**Bigot, A., Ph. D.,** 112 Ave. de Suffren, Paris, France.

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Boudouard, O., 292 Rue Saint Martin, Paris, France, Professeur de Chemie.

Broderick, J. C., (address unknown).

Brown, Thomas G., St. Laurent, Quebec, Canada, Works Manager, Gurney Foundry Co.

Bush, Hiram T., 59 Yonge St., Toronto, Ont., Canada, President, Universal Silicates, Ltd.

Chu, Kea Hin, FC 562 Medhurst Rd., Shanghai, China.

Clare, H. L., Hespeler, Ont., Canada, Sales Manager, Stamped & Enamelled Ware.

Cleverly, Wm. B., Jr., 652 Leek Rd., Stoke-on-Trent, England, Messrs. John Slater, Ltd., Berry Hill Brick Works.

Coad Pryor, E. A., Teddington, England, National Physical Laboratory.

Cobb, John W., Leeds, Yorkshire, England, Professor, Fuel Department, The University.

Cole, G. Percy, Montreal, Canada, Technical Engineer, Dominion Glass Co., Ltd.

Cole, L. Heber, Ottawa, Ont., Canada, Mining Engineer, Mines Branch, Department of Mines.

Corrigan, F. S., Toronto, Canada, Sheet Metal Products Co.

Cote, A. U., Cooksville, Ont., Canada, General Manager, Shale Brick Co. of Canada.

Coulter, Allen S., Reisholz bei Dusseldorf, Germany, Deutsche-Carborundum Werke.

Cronshaw, H. B., Ph. D., Brierley Hill, South Staffordshire, England, Principal, Technical Institute.

Curtis, Algernon Lewin, Chatteris, Cambridgeshire, England, Consulting Expert in Lands, Clays and Refractories, Westmoor Laboratory.

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†Elevated to Active Membership, February, 1921.

Cuthbertson, M. R., Cerro de Pasco, Peru, Superintendent, Brick Plants.

Davidson, T. R., Box 700, Montreal, Canada, Thomas Davidson Manufacturing Co.

Deb, S., 45 Tangra Road, Calcutta, India, Manager, Calcutta Pottery Works.

Dingledine, H. F., Aldershot, Ont., Canada, Factory Manager, National Fire Proofing Co. of Canada, Ltd.

Dufour, G. F., Aniche, (Nord), France.

Emery, George, 4th Ave., West, Hamilton, Ont., Canada, Canadian Porcelain Co.

Erdmann, K., Radenthein, Kærnten, Austria, General Director, Austro-American Magnesite Co.

Fogelberg, Sven, Kosta, Sweden, Direktor's Assistant, Kosta Glass Works.

Foley, Fenwick D., Loch Lomond Road, St. John, N. B.

Fujioka, Koji, Kyoto, Japan, Shofu Porcelain Manufacturing Co.

Gaby, F. A., 190 University Ave., Toronto, Canada, Chief Engineer, Hydro-Electric Power Co.

Gardner, W. J., Meltham, nr. Huddersfield, England, Managing Director, The Meltham Silica Fire Brick Co., Ltd.

Gardner, Wm., Hartington, Ont., Canada, Gardner Feldspar Co.

Gass, Geo. Pool, "The Hollins," The Haulgh, Bolton, England, Director, Entwish & Gass, Ltd.

Gatecliff, John, Rugby, England, Chemist, The Lodge Sparking Plug Co., Ltd.

Gentil, E., 1 bis Place des Saussaies, Paris, France, Engineer, Glaeeries de St. Gobain.

†**Gibson, M. F.**, Toronto, Canada, Managing Director, National Fire Proofing Co. of Canada.

Gildard, Warren R., (address unknown)

Glass, L. G., 603 Queens Ave., London, Ont., Canada, Engineer, McClary Manufacturing Co.

Goddard, W. T., Box 170, Hamilton, Ont., Canada.

Gregg, Henry, Knottingley, England, Gregg & Co.

Griffin, Carl H., Wesseling bei Kœln, Germany, Deutsche Norton Gesselshaft.

Croocock, Alice, Lombard Bldg., 70 Lombard St., Toronto, Canada.

Gunn, James, 59 King Edward Ave., Toronto, Canada, Chemist.

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Havas, A. B., 57 Rohrbacher St., Heidelberg, Germany, Consulting Chemist, Roessler & Hasslacher Chemical Co.

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† Elevated to Active Membership, February, 1921.

Hawley, W. S., Hanley, Stoke-on-Trent, England, Director, George Howson & Sons, Ltd., Eastwood Sanitary Works.

Hayhurst, Walter, The Laund, Accrington, England.

Hesler, N. A., Montreal, Canada, Consumers Glass Co., Ltd.

Hirano, Kosuke, Mantetsu Yogyo, Shiken Kojo, Dairen, Manchuria.

Hodson, G. A., 58 Park Road, Loughborough, England, Managing Director, Hathern Station Brick and Terra Cotta Co., Ltd.

Holland, Job, Box 22, Sheffield, England.

Hoursouripe, J., Palantelen—F. C. C. G. B. A., Republica Argentina.

Ide, Kiyoshi, Amagasaki City, Japan, The Amagasaki Factory, Asahi Glass Co.

Jacobsen, Carl, 7 Malmogade, Copenhagen, Denmark, Professor in Ceramics, Technical High School.

Kato, Mitsu, Uno-ki, Okayamaken, Japan, Managing Director, Uno Fire Brick Co.

Kozo, Kawai, 487 Honjo, Kaminakano, Toyosakimachi, Nishinaligun, Osaka, Japan.

Kelkar, G. D., 847 Sadashive peth, Poona City, Bombay presidency, India.

Kitamura, Y., Kyoto, Japan, Director and Chief Engineer, Shofu Industrial Co., Ltd.

Knudsen, Borgestad, Norway.

Kondo, S., Tokyo, Japan, Tokyo Higher Technical School.

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Bayonne
Merica, Paul D.

Camden
Dobbins, T. Monroe
Enright, Bernard
Kerr, Chas. H.

Chrome
Martens, Paul

East Orange
Brann, Albert

Elizabeth
Healey, A. S.

Flemington
Fulper, Wm. H.
Stangl, J. M.

Fords
Brinkman, S. G.
Hansen, Abel

Glen Ridge
Cox, Harold N.

Gloucester City
Miner, Harlan S.

Haddonfield
Yearsley, Howard L.

Harrison
Koerner, Walter E.
Moss, Lester M.
Yung, W. A.

Hoboken
Footitt, F. Farnsworth
Keuffel, Carl W.

Jamesburg
Foersterling, Hans

Jersey City
Acheson, Albert E.
Depneler, J. H.
McNaughton, Malcolm

Keasbey
Whitaker, Fred A.

Lambertville
Foltz, Andrew

Landing
Mitscherling, W. O.

Matawan
Barker, Charles E.
Eskesen, Bennet K.
Matawan Tile Co.

Maurer
Jones, Cecil

Metuchen
Bloomfield, Chas. A.
Bloomfield, Howard W.
Campbell, A. R.
Edgar, David R.
The Edgar Plastic Kaolin Co.
Minton, R. H.

Millville
Barton, G. E.
Patch, James B.
Whitall-Tatum Co.

Minotola
Smith, Wilbur R.

Newark
Allison, LeRoy W.
Hanovia Chemical & Mfg. Co.
Memory, N. H.

New Brunswick
Brown, Geo. H.

Nutley
Stover, J. Homer

Old Bridge
DeVoe, Chas. H.
Old Bridge Enameled Brick & Tile Co.

Perth Amboy
Brennan, Geo. L.
Bruner, Willard L.
Geiger, Charles F.
Grueby, Wm. H.
Hill, Charles W.
Howat, Walter L.
Hoyler, Fritz W.
McHose, Malcolm M.
Perth Amboy Tile Co.
Pfeiff, Carl Heinrich
Roessler, Franz
Staudt, August
Will, Otto W.

Rahway
Balz, Geo. A.

Sayreville
Fisher, Douglas J.

South Amboy
Nagle, Michael F.
Tatton, Joseph

South River
Jacquart, Chas. E.
Wright, Marcus S.

Tenafly
Solon, Leon V.

Toms River
Engle, C. C.

Trenton
Bedson, William
Boughey, Joseph
Bowman, Oliver O.
Bowman, Wm. J. J.
Briggs, Leonard S.
Brown, Leslie
Burroughs, Francis H.
Chambers, A. R.
Cook, Chas.
Dennis, J. Alfred
Dinsmore, B. B.
Forst, Arthur D.
Forst, Daniel P.
Golding, Chas. E.
Hamilton, James
Hoffman, Geo. E.
Kahn, Harry J.
Lawton, Lewis H.
Lovatt, John
Maddock, A. M., Jr.
Maddock, Henry E.
Maddock, John
Maddock, John B.
McAllister, James E.
Miller, Donald M.
Philips, Wilson A.
Pohle, Louis
Schermerhorn, Joseph A.
Silvers, James L.
Simcoe, George
Sinclair, Herbert
Solon, Marc
Star Porcelain Co.
Stover, Edward C.
Trenton Flint & Spar Co.
Turner, James
Veritas Firing System
Wainford, Richard H.
Whitehead, Fred
Wilkinson, Samuel
Williams, John A.
Wright, John M.

Vineland
Kimble, Herman K.

Washington
Humphrey, Harold P.

West Englewood
Kraus, Lysle R.

Westfield
Parr, John R.

Woodbridge
Allen, F. B.
Clare, R. L.
Grace, Richard P.
Kreger, John M.
Long, R. N.
Ryan, John F.
Ryan, Lawrence C.
Ryan, P. Joseph

NEW YORK

Alfred
Binns, Chas. F.
Binns, Norah W.
Castro Oliveira, Rodolfo
Collin, Louis
Shaw, Joseph B.

Angola
Balmert, R. M.

Astoria
Clark, John

Bronxville
Waller, Alfred E.

Brooklyn
Gleason, Marshall W.
Gleason-Tiebout Glass Co.
Jensen, Chas. H.
Jensen, James Lawrence
Kelly, M. J.
Kraus, Chas. E.
Nies, Frederick H.
Pellerano, Silvio
Tiebout, Cornelius H.

Buffalo
Agge, Franklin
Livingston, H. J.
Rea, Wm. J.
Worsham, Herman

Canandaigua
Keehn, Clarence C.
Kennedy, John H.
Tyler, H. B.

Canastota
Crawford, Edw. A.

Corning
Carder, Frederic R.
Eilers, H. F.
Faulkner, Karl B.
Gregorius, Thos. K.
Gregory, M. C.
Gregory, M. E.
Hostetter, J. C.
Littleton, J. T., Jr.
McCauley, Geo. V.
Maltby, Alfred
Oakley, Walter W.
Sullivan, E. C.
Taylor, Wm. C.

Corona
Saunders, A. E.

Cortland
Cortland Grinding Wheel Co.

Geneva
Frost, Leon J.

Hamburg
Sharp, Donald E.

Ithaca
Liu, S. Y.
Ries, Heinrich

Jewettville
Langworthy, H. S.

Lackawanna
Jewett, Richmond
Lintz, E. H.

LeRoy
Lapp, G. W.

Long Island City
Dalton, Richard F.
Geer, Walter, Jr.
Tucker, Gus M.

Mt. Vernon
Kebler, Leonard

New York City
Acheson, Edward G.
Alexander Hamilton Institute
Bartlett, John H., Jr.
Booraem, J. Francis
Brooks, B. T.
Cooper, George W.
Crane, Chas. W.
Drakenfeld, B. F., Jr.
B. F. Drakenfeld Co.
Engelhard, Charles, Inc.
Eskesen, E. V.
Evatt, Franks G.
Farnham, D. T.
Finney, Robert Spencer
Fiske, J. Parker B.
General Ceramics Co.
Goldsmith, B. B.
Grant, Deforest
Guastavino, Rafael, Jr.
Ichijo, Mokiji
Kingsbury, Percy C.
Kleinfeldt, Henry F.
Lamborn, Lloyd
McPadden, J. H.
Malsch, Werner
Marks, Melville
Marshall, P. M.
Marshall, S. M.
Metz, G. F.
Middleton, G. E.
Moore, Joseph K.
Moore and Munger
Niles, Glenn H.
Olsen, Peter C.
Pitcairn, Wm. S.
Powell, Wm. H.
Pritchard, Geo. A.
Roessler & Hasslacher Chemical Co.
Spier, Harry F.
Staley, H. F.
Stockton-Abbott, Lyle
Stone, Geo. C.
Walton, H. K.
Zeiller, Oscar F.

Niagara Falls
Becket, Frederick M.
Burdick, Percy W.
The Carborundum Co.
Fitzpatrick, John
Harper, John L.
Hawke, C. E.
Kenyon, Spicer
Linbarger, S. C.
Taylor, R. F.
Tone, Frank J.
Walker, Prescott H.
White, Ray H.

Nyack
Goebel, J., Jr.

Peekskill
Young, Everett T.

Port Jervis
Foskett, John J.
Gillinder, James
Gillinder Bros.

Rochester
Bausch & Lomb Optical Co.
Chamberlain, C. H.
Chorman, O. I.
Geisinger, E. E.
Kurtz, John C.
Montgomery, Robert J.
The Pfaudler Co.
Scott, M. R.
Walcott, A. J.

Schenectady
Barringer, L. E.
Cermak, Frank
Creighton, E. E. F.
Treischel, Chester
Weber, August, Jr.

Solvay
Haaf, George

Syracuse
Cannan, Wm.
Haley, Mark A.
Kerr, W. B.
McGee, Earle N.
Milford, L. R.
Onondaga Pottery Co.
Pass, Richard Henry
Porter, J. Edward
Robineau, S. E.
Salisbury, Bert E.
Schram, Edward

Tottenville
Klinefelter, T. A.
Williams, George A.

Victor
Locke, F. M.
Reagan, F. H.

West New Brighton
Jones, Robert W.

Woodstock
Whitehead, Ralph R.

Yonkers
Reid, W. H.

NORTH CAROLINA

Badin
Fickes, W. M.

NORTH DAKOTA

Grand Forks
Cable, Margaret K.

Hebron
Weigel, Charles

OHIO

Akron
Deaver, L. A.
Knight, M. A.
Motz, W. H.

Barberton
Austin, Arthur Oswin

Bedford
McCormick, O. C.

Briggsdale
Cheney, M. B.

Bucyrus
Brown, Davis
Penfield, L. W.

Cambridge
Arbenz, Fred J. A.
Casey, Charles L.

Camp Sherman
Moore, E. J.

Canal Dover
Polen, Geo. A.

Canton
Cable, Davis A.
Canton Stamping & Enameling Co.
Hostetler, G. R.
Keplinger, Robert B.
Manion, L. W.
Stark Rolling Mill Co.
Taylor, Royal W.

Chippewa Lake
Cassady, Bertram L.

Cincinnati
Burt, S. G.
Dittmar, Carl
Kahn, Isaac
Koch, Chas. F.
Limberg, Frank
Metzner, Otto
Pfau, Charles
Robinson, Louis G.
Stewart, John G.

Cleveland
American Dressler Tunnel Kilns, Inc.
Baccus, Mrs. Julia F.
Blackburn, C. A.
Blair, Wm. P.
Brooks, Charles T.
Christie, J. M.
Clark, Wm. M.
CoVan, H. E.
Cowan, R. Guy
Crawford, George E.

Cushman, H. D.
Day, O. L.
Dougherty, Robert H.
Dressler, Conrad
Dressler, Philip
Forester, Herbert
Forsyth, J. H.
Fuller, Ralph L.
Giesey, V. A.
Gorton, Arthur F.
Greenough, M. B.
Harshaw, Fuller & Goodwin Co.
Hasslacher, George F.
Hays, George H.
Herron, James H.
Inman, G. E.
Landrum, R. D.
Morrow, Robert P.
Preston, F. C.
Radabaugh, N. B.
Rand, C. C.
Riblet, Bertha
Rixford, Guy L.
Roll, Edw. E.
Smith, Harry W.
Stone, Charles H., Jr.
Stowe, C. B.
Stowe, G. T.
Strommer, L. T.
Swift, George C.
Walden, A. S.
Weil, Edgar H.
Williams, C. W.

Columbus

Auld, F. Howard
Bachman, P. S.
Bole, G. A.
Callahan, H. D.
Curran, Hugh
Dean, Chas. A.
Douda, Henry W.
Dunbar, George S.
Ebinger, D. H., Jr.
Harrop, Carl B.
Henderson, H. B.
Henry, A. V.
Jenks, H. P.
Kraner, Hobart M.
Krehbiel, J. F.
Lord, N. W., Jr.
Lovejoy, Ellis
Merritt, L. M.
Ogden, Ellsworth
Orton, Edward, Jr.
Purdy, Ross C.
Reeb, H. E.
Richardon, W. D.
Scholes, S. R.
Schurecht, H. G.
Smith, Charles A.
Stout, Wilber
Stull, Ray T.
Tilton, Earl
Watkins, Ray T.
Watts, Arthur S.

Conneaut

Dunn, Frank B.
Dunn Wire Cut Lug Brick Co.

Coshocton

Raiff, David A.

Crooksville

Pitcock, Lawrence

Cuyahoga Falls

Brandt, George F.
Humphrey, Dwight E.

Dayton

Crume, Wm. H.
Geiger, Carl F.
Henry, Frank R.
Justice, Ithamar M.
Knapp, E. W.
McElroy, R. H.

East Liverpool

Ashbaugh, Charles C.
Brian, George
Brown, Lawrence H.
Cawood, Richard L.
The Colonial Co.
Cronin, W. Kress
Cunning, W. E.
Earl, Oliver N.
The Golding Sons Co.
Hall China Co.
Harker, H. N.
The Harker Pottery Co.
Homer-Laughlin China Co.
Irwin, Dewitt
Knowles, Taylor & Knowles Co.
Louthan, Wm. B.
The Louthan Manufacturing Co.
Manor, John M.
Mason, F. Q.
D. E. McNicol Pottery Co.
Muessig, C. Nick
Poole, Joshua
Potters Supply Co.
John H. Sant & Sons Co.
Sant, Richard C.
Sant, Thomas H.

Smith, H. Dan
Smith-Phillips China Co.
Standard Pottery Co.
Thomas, George W.
R. Thomas & Sons Co.
Thompson, Dale
Turnbull, Lance
Vodrey, Wm. E.
Vodrey Pottery Co.
Walker, Chas. H.
West End Pottery Co.

East Palestine
George, W. C.
W. S. George Pottery Co.

Elyria
Elyria Enameled Products Co.
Guthrie, Lee
King, Walter A.
Poste, Emerson P.
Rice, Bryan A.
Wigfield, C. L.

Findlay
Child, J. L.

Fostoria
Cramer, W. E.

Franklin
Montgomery, E. T.

Fredericksburg
Coxon, J. Frederick

Gallon
Freese, H. H.

Haviland
Mumma, C. M.

Klondyke
Kraus, Louis P., Jr.

Lancaster
Frink Pyrometer Co.
Schurtz, D. D.
Sharp, Chester L.
Swinnerton, B. B.

Lima
Fenton, Harry W.

Logan
Cole, M. J.

Magnolia
Gunther, Franklin W.
Theobald, Erwin F.

Mansfield
Adams, Lewis A.
Barnes, T. R.

Massillon
Burt, F. M.
Massillon Stone and Fire Brick Co.

Middletown
American Rolling Mill Co.
Rupp, Edwin M.

Minerva
Cook, John H.
Owen China Co.

Newark
Young, C. B.
Zwermann, Theodore

New Philadelphia
DeWitt, Bert G.

New Straitsville
Blum, John W.

Niles
Niles Fire Brick Co.

Perrysburg
Brown, Edmund

Perrysville
Pyatt, Frank E.

Piqua
Hoehl, Joseph W.

Poland
Kanengeiser, Fred R.

Roseville
Brand, J. J. Fred

Rossford
Edward Ford Plate Glass Co.

Salem
Lamont, R. A., Jr.
Salem China Co.
Sebring, F. H., Jr.

Salineville
Larkins, Samuel B.

Sandusky
Frey, Wm. J.
Hare, Robert L.
Holmes, J. C.
Universal Clay Products Co.

Sebring
French China Co.
Gahris, Willard I.
Limoges China Co.
Saxon China Co.
Sebring, Charles L.
Sebring Pottery Co.
Sproat, Ira E.

Seville
Minton, C. R.

Springfield
Vance, Edward D.

Steubenville
Hollingsworth, C. M.
Steubenville Pottery Co.

Tiffin
Kalbfleisch, G. C.
Schory, Virgil S.
Tillotson, George S.

Tiltonville
Edwards, W. L.
Lindley, Jacob
McLaughlin, John

Toledo
Brownlee, Wm. K.
Brownlee, Wm. L.
Buckeye Clay Pot Co.
Corl, Robert M.
Fisher, E. E.
Garrod, Fred B.
Hess, Henry W.
Minehart, A. G.
Nolan, C. J.
Richardson, E. A.
Robinson, J. D.
Zopfi, Albert S.

Toronto
Hartford, Frank M.

Uhrichsville
Brower, Fred W.
Myers, Scott P.

Wellsville
Blewett, J. B.
East Liverpool Potteries Co.
Ewing, R. F.
Hibbins, Thomas A.
Martz, Joseph A.
Purinton, Bernard S.

West Lafayette
Shaw, Lucian
Strong, Thomas L.

Willoughby
Rentschler, M. J.

Zanesville
American Encaustic Tiling Co.
Brown, L. K.
Brush, George S.
Burton, R. C.
Carling, John P.
Crew, H. F.
Evans, A. W.
Fraunfelter, Chas. D.
Gonder, Lawton G.
Grant, Frederick J.
Hagar, Donald
Herrold, R. P.
Krause, George
Lillibridge, H. D.
Miller, Emerson R.
McCoy, William
Mosiac Tile Co.
Niblock, Chas.
Ohio Pottery Co.
Owens, J. B.
Pence, F. K.
Reed, Adam
Rhead, Frederick H.
Rhead, Mrs. Frederick H
Rhead, Harry W.
Schmid, A. F.
Shultz, J. Emmet
Snider, Paul C.
Tefft, T. Dwight
Trifonoff, Boris
Weller, Samuel A.
Whitmer, J. D.
Young, Russell T.

Youngstown
Aubrey, Arthur J.

OKLAHOMA

Checotah
Harrell, E. R.

Oklahoma City
Harris, Marshall W.

Sapulpa
Bartlett, Edward E.
Brenner, R. F.

OREGON

Forest Grove
Martin, Earle V.

Portland
Pohs, Frank J.
Portland Stove Works
Smith, A. M.
Wethey, Arthur Harvey, Jr.
Williams, Ira A.

PENNSYLVANIA

Allentown
Hersh, Lewis E.

Arnold
Forman, L. P.
Sewell, Sidney I.
Williams, Warren S.

Beaver
Hice, Richard R.

Beaver Falls
Beaver Falls Art Tile Co.
Bently, Louis L.
Hardesty, B. D.
Hunt, Frank S.
Mayer, A. E.
Richardson, Ernest
Sladek, George E.
Walker, Francis W.
Walker, Francis W., Jr.

Bellefonte
Harvey, Ives L.

Belle Vernon
Weaver, James P.

Blandburg
Caruthers, Raymond G.

Brookville
Bloxsom, John J.
Myers, Elmer E.

Butler
Troutman, Frank E.

Charleroi
Jacobs, W. M.
Stoneman, Wm. N.
Wright, J. W.

Claysburg
Kurtz, Thomas N.

Clearfield
Paterson, Alexander

Columbia
Russel, John W.

Creighton
Cox, S. Frank
Fulton, C. E.
Gelstharp, Frederick
Koupal, Walter G.
Lardin, R. H.
Linder, C. S.
Minton, G. Z.
Truby, Harry A.

Crum Lynne
Stephani, Wm. J.
Stull, Jos.

Curwensville
Crescent Refractories Co.
McKinley, J. M.

Derry
Emrick, W. A.
Fritz, E. H.
Pittsburgh High Voltage Insulator Co.

Dickson City
Early, Joseph W.

DuBois
Jackson, H. W

Dunbar
Greenwood, G. W.

Easton
Brian, Chas.
Hart, Edward

Fallston
Rainey, Lloyd B.

Ford City
Panchot, L. D.

Jeanette
Smith, Maurice A.

Kittanning
George, J. S.
Martin, S. C.

Kushequa
Blair, J. A.

Lancaster
Horning, Roy A.

Lansdowne
Davis, John B.

Latrobe
Ward, J. W.

Lewistown
Lord, F. G.
Pennsylvania Pulverizing Co.
Woods, Wm. J.

Monaca
Tait, Howard J.

Mt. Union
Harvey, F. A.

Natrona
Darlington, Homer T.

New Bethlehem
Luke, Chas. H.

New Brighton
McDanel, Walter W.
Smith, Perry A.

New Castle
Brain, George
Hornung, Martin R.
Kirk, Charles J.
Kirk, H. S.
Mellor, F. G.
Morris, George D.
Smith, James M.

New Eagle
VanMoore, A. L.

New Hope
Garve, T. W.

Norristown

Sheppard, Mark

Orviston

Harvey, J. Ellis

Palmerton

Ashman, Alfred O.
Breyer, Frank G.
Holstein, L. S.

Paxtonville

Fowler, William E.

Philadelphia

Abrasive Co.
Applegate, D. H., Jr.
Ayres, Elwood B.
Bacon, Chas. C.
Borkey, J. H.
Brown, Richard P.
Conkling, Samuel O.
Fulweiler, Walter H.
Galloway, Walter B.
Gibbs, Arthur E.
Goheen, John P.
Griffith, R. E.
Hall, Clarence A.
Hibbs, Jos. S.
Hill, E. C.
Knollman, H. J.
Moore, H. W.
Pettinos, Geo. F.
Philadelphia Drying Machinery Co.
Plusch, H. A.
Ritschy, Donald P.
Saunders, Wm. E.
Stanger, Frederick
Thwing, C. B.
Vane, A. S.
Wood, C. P.
Worth, S. Harry

Pittsburgh

Amsler, Walter O.
Babcock, M. G.
Bacon, Raymond F.
Berkey, Paul L.
Blake, A. E.
Boudreau, James C.
Buck, D. M.
Buckley, J. L.
Chandler, A. H.
Chatham, C. W.
Christman, C. E.
Clayter, Frederic C.
Crawford, J. L.
Cruikshank, J. W.
Denk, F. J.
Dixon, Henry L.
H. L. Dixon Co.
Donahoe, Frederic W.
Elledge, H. G.
Emminger, Thos. F.
Farren, Mabel C.
Ferguson, Robert F.
Fettke, Chas. R.
Gilmore, R. B.
Good, Harry N.
Goodman, A. H.
Gray, Arthur E.
Greaves-Walker, A. F.
Guenther, Emil B.
Hammer, John M.
Hansen, J. E.
Harbison-Walker Refractories Co.
Hepplewhite, J. W.
Houser, A. T.
Howe, Raymond M.
Hower, H. S.
Hunt, Marsden H.
Johnston Brokerage Co.
Kier, Samuel M.
Kier Fire Brick Co.
Kimes, A. W.
Lyon, P. W.
McDowell, J. S.
McLain Fire Brick Co.
Macbeth-Evans Glass Co.
Miller, Julius J.
Mossman, P. B.
National Fireproofing Co.
Offill, Paul M.
Ogale, G. P.
O'Leary, T. A.
Pennsylvania Salt Mfg. Co.
Peregrine, C. R.
Phoenix Glass Co.
Pierce, Robert H. H.
Pittsburgh Plate Glass Co.
Reed, H. M.
Robertson, H. S.
Rochow, W. F.
Sauereisen, C. Fred
Seaver, Kenneth
Silverman, Alexander
Smyser, Albert E.
Standard Sanitary Mfg. Co.
Stewart, Andrew H.
Sutton, Willard J.
Tillotson, E. W.
Unger, J. S.
United States Glass Co.
Varshnei, B. D.
Vitro Manufacturing Co.

Vogt, C. C.
Vollkommer, Josef
Wenning, W. F.
Willetts, H. G.
Winkleman, E. J.

Point Marion
L. J. Houze Convex Glass Co.

Reading
Hettinger, Edwin L.
Seasholtz, J. M.

Royersford
Wells, R. D.

Scranton
Bour, Laurence J.

State College
Moore, Elwood S.

St. Marys
Grant, W. Henry
Ramsay, J. D.

Tarentum
Jones, Richard E.
Morris, Paul R.
Parkinson, S. C.

Tyrone
Hepler, I. F.

Uniontown
Nye, C. P.

Vanport
Hall, Herman A.

Washington
Algeo, A. M.
Brett, R. C.
Duval D'Adrian, A. L.
Findlay Clay Pot Co.
Flint, Francis C.
Frazier, C. E.
Lambie, J. M.
Lloyd, A.
Ross, Donald W.
Thompson, Harry M.

Watsontown
Owens, Francis T.
Tefft, C. Forrest

Wilkinsburg
Bell, M. L.
Coe, John H.

RHODE ISLAND

Central Falls
Kline, Z. C.

Providence
American Emery Wheel Works
Harding, Browne

SOUTH DAKOTA

Brookings
Gernon, Ursula F.

TENNESSEE

Chattanooga
Mahoney, W. T.
Patten, D. M.

Nashville
W. G. Bush & Co.

Puryear
Harker, O. A., Jr.

Whitlock
Mandle, Sidney

TEXAS

Dallas
Fraser, W. B.
Ryan, J. J.

Denton
Lacy, Miss Mattie Lee

Fort Worth
Porter, F. B.
Smith, R. G.

McQueeney
Potts, Amos

UTAH

Murray
Myers, Chas. H.

Salt Lake City
Ellerbeck, Wm. L.
A. A. Garrison

VIRGINIA

Roseland
Taylor, R. P.

WASHINGTON

Auburn
MacMichael, P. S.
Zwerner, Carl G.

Chewelah
Dolman, C. D.

Clayton
Davies, J. L.

Renton
Cake, B. F.
Rogers, Gregory L.

Seattle
Geijsbeek, Samuel
Heath, Fred T.
Keenan, John Francis
Martin, Leonard A.
Wilson, Hewitt

Spokane
Bryan, M. L.
Goodner, Ernest F.
Oudin, Chas. P.
Washington Brick Lime and Sewer Pipe Co.

Taylor
Lemley, W. E.

WEST VIRGINIA

Berkeley Springs
Carman, C. F.

Charleston
Brown, Wilbur F.
Henshaw, S. B.

Chester
Smith, Will L., Jr.
The Taylor Smith and Taylor Co.

Clarksburg
Bracken, Lloyd
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